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CMM Appraisal Framework, Version 1.0

Steve Masters
Carol Bothwell

February 1995

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CMM Appraisal Framework, Version 1.0



Steve Masters

CMM-Based Appraisal (CBA) Project

Carol Bothwell

Computer Sciences Corporation

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CMM Appraisal Framework

Abstract: This technical report describes version 1.0 of the CMM Appraisal Framework (CAF). This framework describes the common requirements used by the CMM-Based Appraisal (CBA) project in developing appraisal methods based on the Capability Maturity Model (CMM) for Software, Version 1.1 [Paulk 93a]. The CAF provides a framework for rating the process maturity of an organization against the CMM. The CAF includes a generic appraisal architecture for CMM-based appraisal methods and defines the requirements for developing CAF compliant appraisal methods.

1 Background and Context

1.1 Who is the Intended Audience for this Document?

Anyone interested in the conduct of process appraisals can benefit from reading this document. The primary targets for this document are:

- Lead appraisers.
- Appraisal method developers.
- Members of appraisal teams.
- Sponsors of appraisals.
- Process improvement practitioners.

1.2 How is this Document Structured and What Is Its Scope?

Part 1 of the CAF includes background information relating the CAF to key user considerations. It addresses:

- What the CAF is.
- How the CAF can be used.
- How the CAF relates to existing reference models and appraisal methods.
- How the CAF relates to existing documentation.
- The sponsor needs which drove CAF development.
- The specific objectives of the CAF.
- The principles and design constraints that guided CAF development.

Part 2 describes the architecture of CAF appraisal methods. It describes the context of CAF appraisals, identifies the major CAF appraisal method families, itemizes the activities that make up CAF appraisals, and describes the major data transformations that occur during CAF appraisal execution.

Part 3 provides the CAF appraisal method requirements. It is subdivided into sections that:

- Group requirements by topic.
- Provide related appraisal activity data flow diagrams.
- Provide explanations of requirements that include definitions, rationale, factors for consideration, and examples.

Appendices provide the following information:

- Appendix A provides a list of all CAF requirements.
- Appendix B shows a mapping of the CMM key practices to KPA goals.
- Appendix C is a glossary of key terms.
- Appendix D provides a list of references.

The scope of the CAF V1.0 pertains to appraisal methods that are SEI CMM-based. The CAF is not an appraisal method. Rather, it is a set of minimum requirements and guidelines to be used by method developers in designing methods that are CAF compliant. Just as the CMM is an abstract model that needs to be instantiated in real practice in a software organization to have meaning, the CAF needs to be instantiated in a real appraisal method.

All CAF requirements are listed in Section 3 of this document. The reader should not construe any discussion in Sections 1 and 2 to be implicit requirements. These two parts contain explanatory information which will help to prepare the reader for the requirements section.

1.3 How Can This Document Be Used?

This document can be used in several ways, depending on end user perspective.

The CAF provides lead appraisers with an aid for training appraisal team members.

The CAF provides appraisal method developers with a tool for designing and developing CMM-based appraisal methods.

The CAF provides appraisal team members with an explanation of appraisal requirements.

The CAF supports appraisal sponsors and lead appraisers in:

- Assessing whether or not a specific appraisal method satisfies sponsor business needs.
- Assessing the trade-offs of using a specific appraisal method.

The CAF supports process improvement practitioners by letting them know how an appraisal team will base rating judgments for individual CMM components in a CAF compliant appraisal method.

1.4 What is the CMM Appraisal Framework (CAF)?

The CAF is a framework for developing, defining, and using appraisal methods based on the Software Engineering Institute's (SEI) Capability Maturity Model (CMM) for Software. The CAF provides a framework for rating the process maturity of an organization against a generally accepted reference model through the use of an appraisal method. The CAF V1.0 uses the CMM Version 1.1 [Paulk 93a, Paulk 93b] as its associated reference model. The CAF and its revisions will be applicable to other models in the future provided they comply with the CMM architecture. If future versions of the CMM have an architecture different from CMM Version 1.1 so that portions of the existing CAF are no longer applicable, an updated version of the CAF will be written.

The CAF includes an architecture for a generic CAF appraisal method and a description of CAF appraisal method requirements. How method developers implement CAF requirements is a method specific choice. The CAF does not directly measure risk or process improvements or identify lost market opportunities. It is up to users of appraisal method outcomes to translate the results of CAF appraisals into meaningful information relative to the sponsor's business needs.

When an appraisal method meets all of the CAF requirements, it is said to be fully CAF compliant. Future versions of the CBA project's SCE and CBA IPI appraisal methods will be CAF compliant.

Requests can be made to the SEI to determine whether or not an appraisal method developed outside of the SEI is CAF compliant. The SEI will charge a fee for such services. The point of contact for such a request is SEI customer relations.

The CAF was designed to help improve consistency within a specific appraisal method and across different appraisal methods and to help appraisal method developers, sponsors, and users understand trade-offs associated with various methods. Not all appraisal methods are expected to be fully CAF compliant. Rather, the CAF provides a standard by which one can evaluate CAF compliance and assess the trade-offs associated with a method relative to meeting specific sponsor business and appraisal goals.

Figure 1-1 shows the relationships among reference models, the CAF, and appraisal methods.

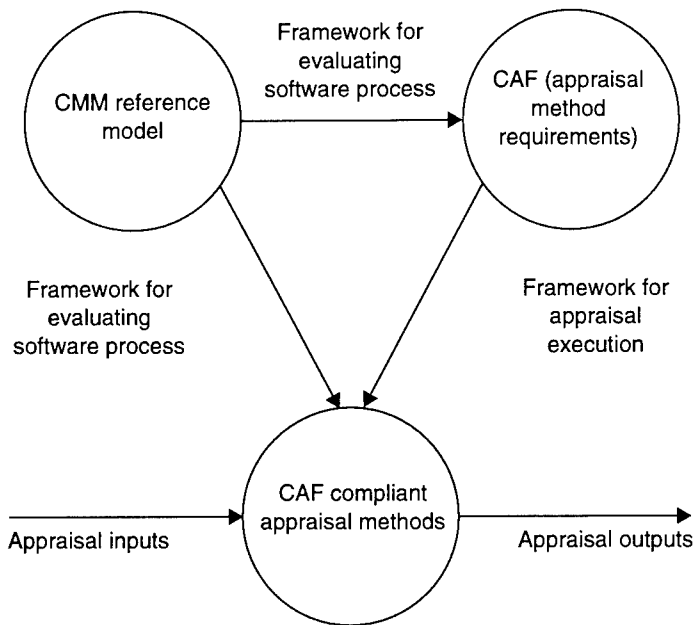


Figure 1-1: Relationships Among the CMM, the CAF, and CAF Compliant Appraisal Methods

The CMM provides a framework for judging the maturity of an organization's software process. The CAF provides requirements and guidelines for developing, defining, and using appraisal methods based on the CMM. Together the CMM and the CAF describe "what" must be accomplished by CAF compliant appraisal methods. The appraisal methods themselves detail "how" to transform an organization's software process data into information of value to meeting an organization's business needs.

1.5 What is the Relationship of the CAF to Other CBA Documents?

In the CAF V1.0, the CMM V1.1 is the reference model used. Multiple appraisal methods can be developed that are consistent with CAF requirements. Each appraisal method will have its own documentation. A typical appraisal method document suite will address such issues as:

- Use by lead appraisers and appraisal sponsors to determine the applicability of a method to a particular business situation.
- Use by appraisal sponsors to integrate appraisals into their business operations (for example, to identify the manner in which an appraisal might be integrated into the software supplier acquisition process).
- Use by appraisal teams to carry out appraisals and to provide detailed instructions for each of the activities necessary to carry out an appraisal.
- Use by appraisal instructors to train appraisal teams.

Modular parts of these documents are referred to as appraisal method assets. Figure 1-2 depicts the relationships between CMM-based appraisal method assets. The inner ring, the CMM, is the model used as a framework for evaluating an organization's software process.

The CAF is the framework for executing an appraisal using this model. The next ring contains common assets -- those artifacts, tools, and techniques that can be shared across specific methods. The outer ring depicts CAF compliant appraisal methods, which use the published versions of the CMM and CAF.

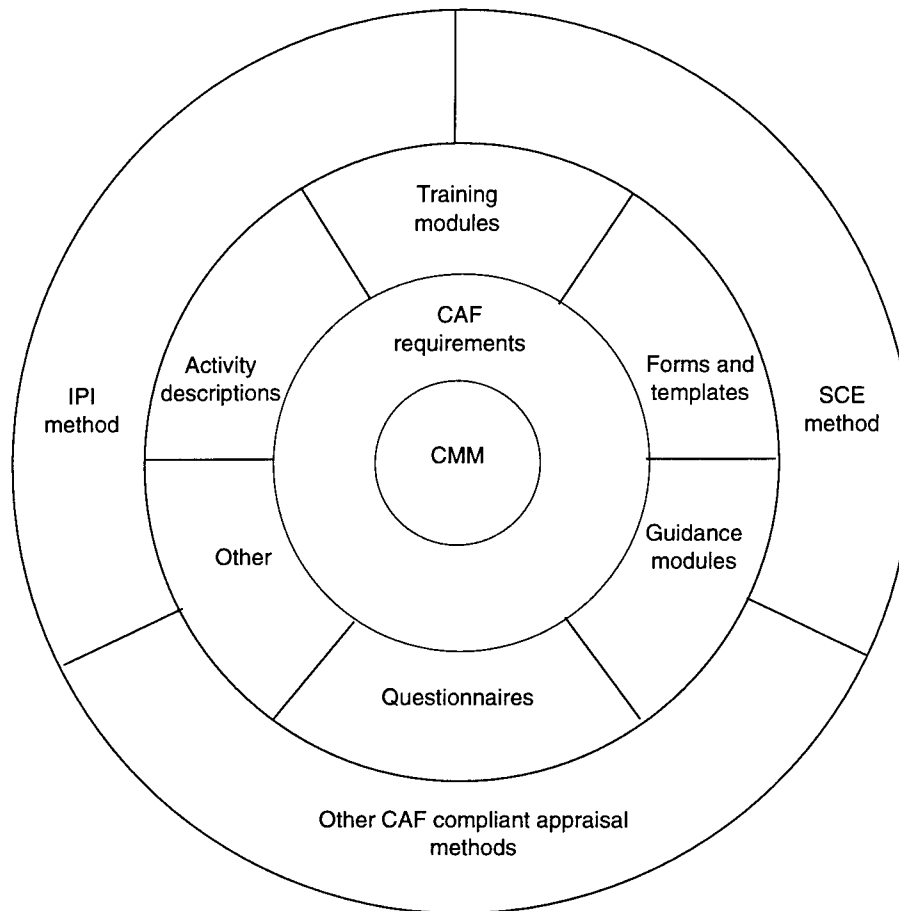


Figure 1-2: CBA Concept Diagram

This CBA concept of appraisal assets acknowledges and supports three fundamental characteristics of the current appraisal environment:

- There are different sponsor and user needs that must be met by appraisal methods.
- There are many potential appraisal method users in the software community that need to be supported.
- Although there are many possible types of appraisals, many of them share similar objectives and are variations on a common theme.

1.6 What Sponsor Needs Are Addressed in the CAF?

The CAF is intended to help address sponsors' fundamental appraisal needs. For example:

- Ensure that appraisal results contribute directly to software process improvement.
- Optimize appraisal value.
- Ensure appraisal reliability.
- Facilitate "buy-in" by the appraised organization.

These four goals can be operationalized to measure the success of any particular appraisal method. For example, "success" might be measured as the percentage of the findings of the method that are translated into specific process improvement actions. Appraisal value could be measured by cost, time, or sponsor surveys, and appraisal reliability can be tied to measures of the repeatability of its process and predictability of its results. "Buy-in" could be measured by a survey of the appraised organization's opinion of the appraisal results.

The ultimate value of the CAF is in its ability to meet these four goals.

1.7 What are the Objectives of the CAF?

The CAF is intended to meet several objectives:

- Define requirements for CAF compliant methods.
- Provide guidance for comparing different methods.
- Define CAF compliant method components and the relationships among them.
- Make public an explicit definition of the CAF compliant method rating process and its prerequisites.

Meeting these objectives should indirectly help achieve the following:

- Reduce inconsistencies in appraisal method use.
- Increase comparability of different appraisal methods and their results.
- Increase predictability and consistency of appraisal results.
- Increase specificity of actionable appraisal results.
- Allow flexibility, but encourage consistency, in appraisal method development.

Community requirements collected by the SEI during the 1992-1993 time frame can be summarized in the following broad areas:

1. Baseline the SEI appraisal methods.
2. Make the methods public.
3. Incorporate the CMM V1.1 into the SEI methods.
4. Align assessment and evaluation methods with each other.
5. Define a process for evolving and transitioning these SEI methods.

The CAF principally addresses the fourth item, aligning methods with each other. Methods that are CAF compliant should be consistent with one another. It is also a mechanism for achieving the transition of SEI methods to the software community (fifth item). A long term, indirect goal of defining the CAF is to encourage development of reusable appraisal method assets for use by future method developers.

1.8 What Design Goals Are Built into the CAF?

Several design goals were used to guide the development of the CAF:

- Define a common CMM-based appraisal architecture.
- Define a common set of CMM-based appraisal activities.
- Ensure appraisal activities are conducted by a team.
- Define a common set of CMM-based appraisal data requirements.
- Define a common CMM-based appraisal rating process.
- Base the rating process on the full structure of the reference model (e.g. CMM components -- key practices, common features, goals, and KPAs).
- Base rating judgments (of the reference model components) on:
 - observations by the appraisal team
 - rules for confirming observations and model coverage (e.g., determining sufficiency for rating)
- Ensure judgment processes used by the appraisal team:
 - look at work actually done
 - simplify the effort to reach decisions
 - are intellectually manageable
 - are linked explicitly to data coverage
- Consider a method fully CAF compliant if it implements all CAF requirements.

1.9 What Are the Basic Principles That Guided CAF Development?

The CAF embodies several basic principles that are important to appraisal method sponsors and users:

- Appraisal teams must ensure that data collection covers the scope of the appraisal.
- Data collected must incorporate what is heard and seen by the appraisal team.
- Data collected must be organized according to the reference model used.
- Full coverage of the reference model components specified in the appraisal plan must be verified in order to rate those components.
- Ratings must be based on the processes actually implemented and practiced.
- If an organization implements the practices in the reference model, they must be rated satisfactorily in those applicable components.
- An organization doesn't have to implement practices as described in the reference model to satisfy the intent of the reference model -- alternates are acceptable provided that they support the key process area (KPA) goals.
- Two types of risks should be considered by appraisal method users: risk inherent in the method chosen to be performed, and risks based on the appropriate execution of that method.

1.10 How Does the CAF Relate to Previously Available SEI Appraisal Methods?

The CAF postdates the introduction of some existing SEI appraisal methods, such as the SPA Method taught to SEI-licensed vendors and SCE Method described in Software Capability Evaluation Version 2.0 Method Description [CBA Project 94]. This does not imply that the CAF and existing appraisal methods are inconsistent, but it does mean that these existing appraisal methods may not be fully CAF compliant and are not necessarily consistent with each other.

The genesis of the CAF is from "A Method for Assessing the Software Engineering Capability of Contractors" [Humphrey 87b]. Since the time that the CMM came into existence, the software community has evolved and matured, and limitations with the existing appraisal methods became apparent. Existing methods can continue to be used as defined; however, it must be understood and acknowledged that they may not be CAF compliant, that they may have limitations, and that there may not be consistency between methods.

2 Appraisal Architecture

This section of the document will describe the architecture of CAF compliant appraisal methods. It will describe the context of CAF appraisals and identify the major appraisal activities and data transformations required of CAF compliant appraisal methods.

2.1 Appraisal Context

Appraisals themselves need to be considered as part of a larger system. Appraisals apply directly to a process improvement system. Figure 2-1 below shows the SEI's IDEAL approach to integrated software process improvement. IDEAL stands for the five phases of the approach: Initiating, Diagnosing, Establishing, Acting, and Leveraging.

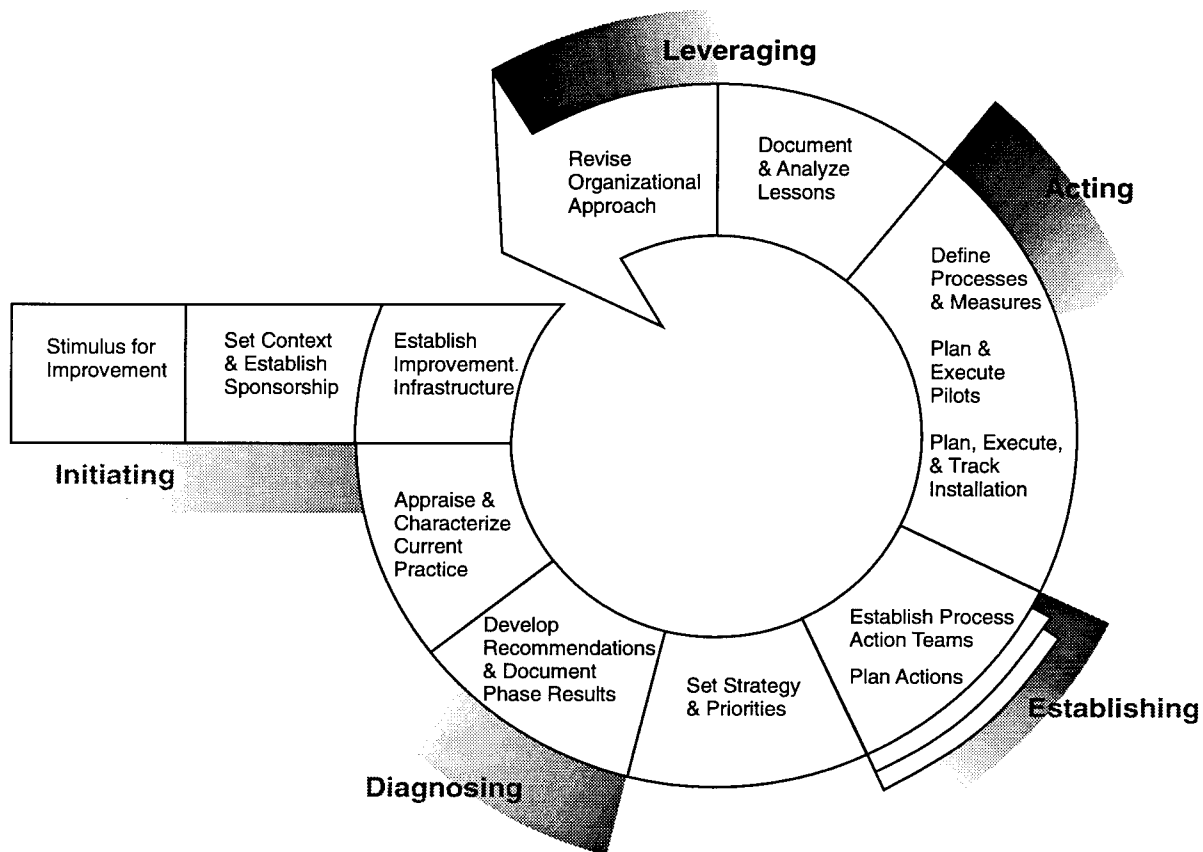


Figure 2-1: IDEAL Approach

Appraisals are part of the Diagnosing phase of the IDEAL process improvement life cycle. They are used to characterize the current practices of an organization. They should be conducted only when there is clear commitment on behalf of their sponsor to use their results. Results of appraisals are used to develop recommendations for furthering process improvement activities.

2.2 Appraisal Families

Appraisals may be grouped into families based on their goals. Three primary families of appraisals are anticipated based on customer/supplier relationships:

- Appraisals whose primary purpose is to provide information to customers useful in selecting software suppliers.
- Appraisals whose primary purpose is to provide information to guide supplier's internal process improvement efforts.
- Appraisals whose primary purpose is to provide information for joint customer/supplier process improvement and/or risk management efforts.

2.3 Appraisal Method Activities

Figure 2-2 illustrates the primary activities that make up a CAF compliant appraisal method. These activities are divided into three (sometimes overlapping) phases:

- Plan and Prepare for Appraisal.
- Conduct Appraisal.
- Report Results.

Planning and preparing for an appraisal includes analyzing the appraisal requirements and developing an appraisal plan to address those requirements as well as selecting and preparing both the appraisal participants and the appraisal team.

Conducting an appraisal includes collecting and recording appraisal data, consolidating it into a manageable set of observations, validating those observations, and making rating judgments based on those observations.

Reporting results includes documenting and presenting appraisal outputs.

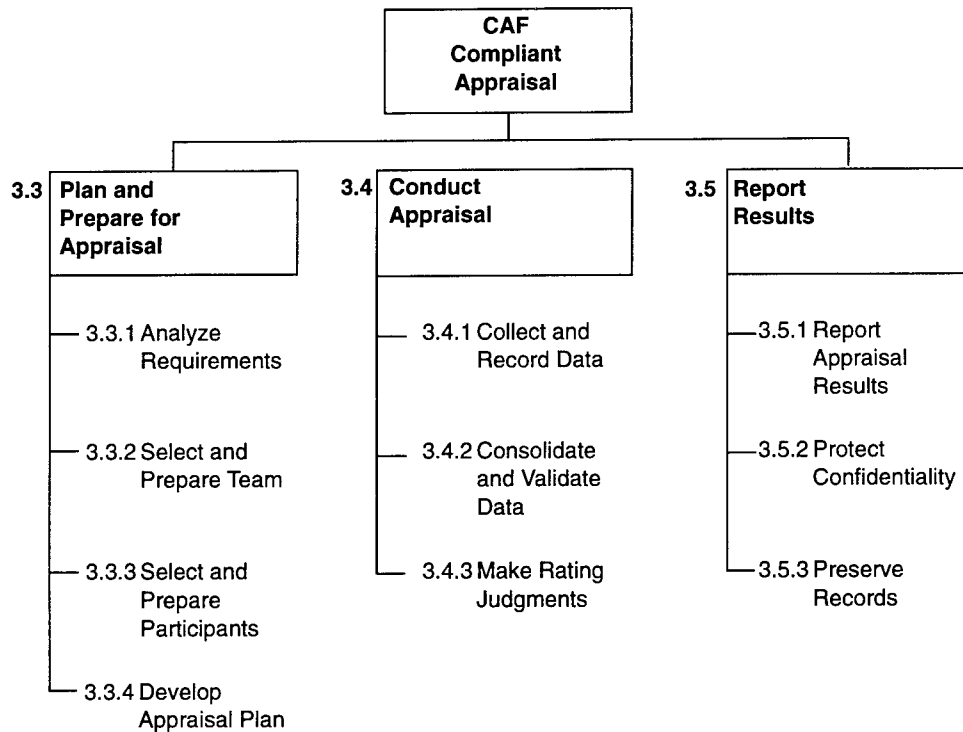


Figure 2-2: Appraisal Activities and Section Numbers in This Document

Section 3 details the CAF requirements for providing guidance for each of these activities.

2.4 Appraisal Related Data Transformations

Figure 2-3 depicts the basic data transformations that occur during a CAF compliant appraisal as raw data is turned into reports detailing appraisal outputs. Major transformations include:

- Recording data in the form of individual notes.
- Consolidating these notes into a manageable set of observations.
- Judging as a team whether or not these observations constitute a valid set of findings.
- Making rating judgments based on these findings.
- Producing appraisal reports.

CAF requirements for addressing each of these transformations are provided in Section 3.

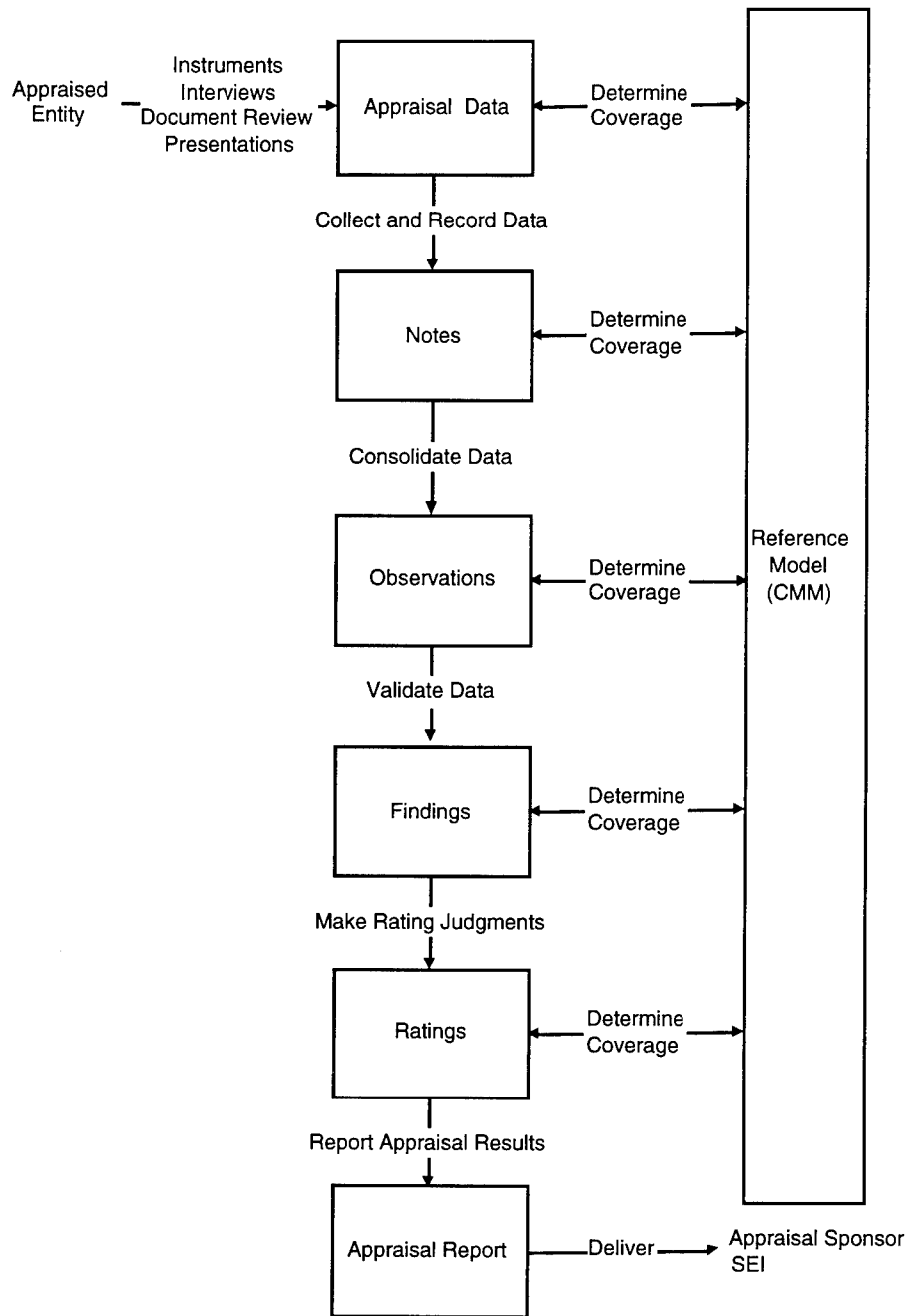


Figure 2-3: Appraisal Data Transformations

3 CMM Appraisal Framework Method Requirements

This section describes the requirements of CAF compliant methods. The following subsections group these requirements by topic. Each subsection consists of a list of requirements followed by a discussion that addresses the rationale for the requirements and factors to consider in implementing the requirements. Flow diagrams are included to illustrate these requirements.

Requirements are numbered R1, R2, R3, etc. and begin with the phrase, "A CAF compliant appraisal method shall...." Requirements fall into three categories:

- Those which identify an asset (such as guidance for a particular activity) that must be provided by a CAF compliant method, but do not constrain its design,
- Those which identify an asset that must be provided by a CAF compliant method and whose design must meet certain minimum criteria,
- Those which identify an asset that must be provided by a CAF compliant method and define it explicitly.

A list of all CAF requirements is included in Appendix A.

3.1 Method Documentation

3.1.1 Documenting CAF Compliance

Requirement: R1. A CAF compliant appraisal method shall be documented, including at a minimum:

- Identifying the version of the CMM and the CAF on which it depends.
- Documenting the manner in which it has implemented appraisal method activities, artifacts and guidance required by the CAF.

Discussion: Appraisal team leaders must be able to select CAF appraisal methods that are compatible with the goals of the appraisals they conduct. In order to do so they must be able to:

- Understand CAF compliant appraisal methods.
- Determine their consistency with published versions of the CMM.
- Evaluate their compliance with published versions of the CAF.

Appraisal team leaders, in selecting appraisal methods for particular appraisal situations, must understand the trade-offs associated with the method's specific implementation of appraisal activities, artifacts, and goals. Different appraisal methods will achieve different balances among appraisal cost, disruption to the appraised organization, and accuracy of appraisal outputs. Appraisal team leaders must be able to understand the impacts of appraisal method choices on each of these appraisal elements.

3.2 Appraisal Phases

Requirement: R2. A CAF compliant method shall provide guidance for three phases of appraisal execution:

- Plan and Prepare for Appraisal.
- Conduct Appraisal.
- Report Results.

Discussion: The activities associated with any appraisal fall into three (sometimes overlapping) phases: planning/preparation, conduct, and reporting results. Activities performed in each phase have significant impacts on appraisal results. Figure 3-1 illustrates these three phases of appraisal execution. The following paragraphs describe the requirements for providing guidance for each of these phases in detail.

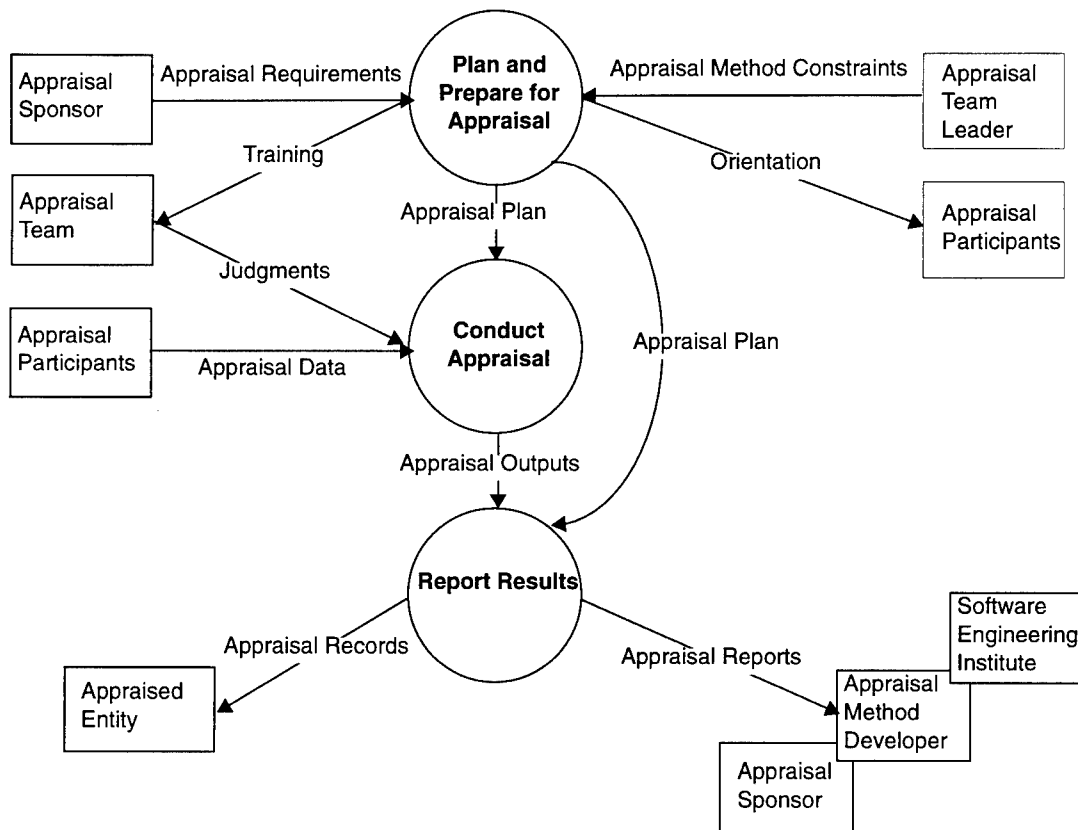


Figure 3-1: Three Phases of Appraisal Execution

3.3 Plan and Prepare for Appraisal

Planning and preparation are the key to success of any appraisal. As illustrated in Figure 3-2, planning and preparation involve analyzing the appraisal's requirements, selecting and preparing the appraisal team, selecting and preparing the appraisal participants, and developing and documenting the appraisal plan. The following subparagraphs specify CAF requirements for addressing each of these topics.

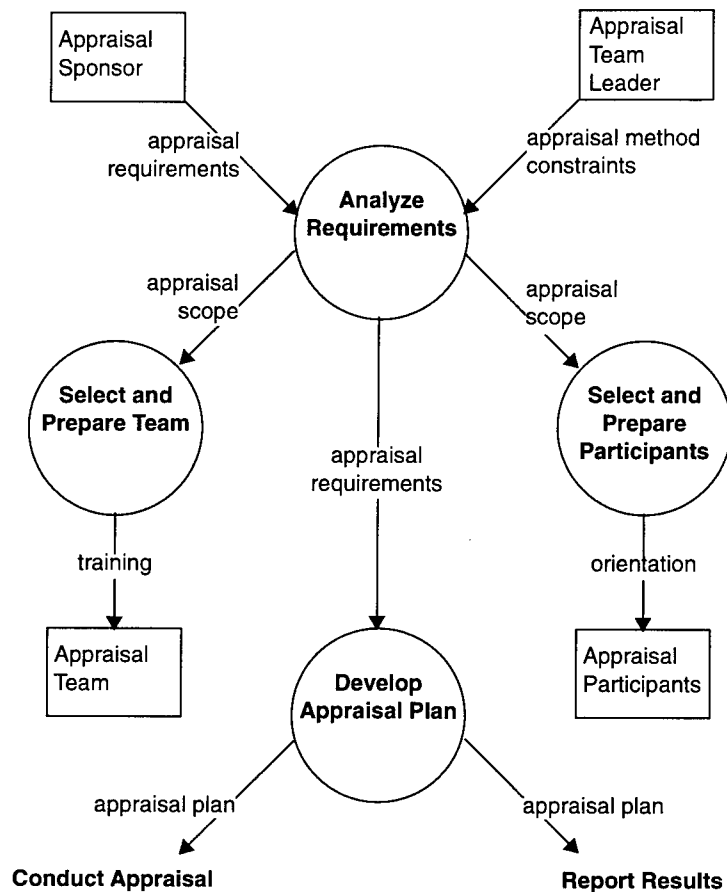


Figure 3-2: Plan and Prepare for Appraisal

3.3.1 Analyze Requirements

Analyzing the requirements for a particular appraisal includes evaluating the sponsor's appraisal goals and constraints, determining that these goals can be achieved within the constraints of a specific appraisal method, determining the appraisal scope, and securing the appraisal sponsor's commitment to proceed with the appraisal process.

3.3.1.1 Identify and Evaluate Goals and Constraints

Requirement: R3. A CAF compliant appraisal method shall provide guidance for:

- Identifying an appraisal's goals and constraints.
- Determining its suitability for the appraisal in light of those goals and constraints.

Discussion: Different types of appraisals have different goals. These goals vary widely and address such diverse business needs as selecting software suppliers and facilitating internal process improvement efforts. A CAF appraisal method may be more suitable for performing some types of appraisals than others. Even when a CAF appraisal method is designed to support a specific type of appraisal, the constraints on performing a particular appraisal of that type, such as availability of participants for interviews, may affect the appraisal method's usefulness. Appraisal sponsors and team leaders should be able to evaluate the trade-offs of achieving appraisal goals with a given appraisal method. With the above guidance, this evaluation can occur early in the planning process.

3.3.1.2 Establish Scope

The scope of an appraisal includes its:

- Capability Maturity Model (CMM) scope.
- Organizational scope.

3.3.1.2.1 CMM Scope

Requirement: R4. A CAF compliant appraisal method shall provide guidance for selecting an appraisal's CMM scope.

Discussion: That portion of the CMM used as a framework for evaluating an organization's software process during an appraisal is its CMM scope. It may include one or more maturity levels, and one or more Key Process Areas (KPAs) within each of these levels. Limiting the number of KPAs and/or maturity levels used in the appraisal has the effect of focusing the investigation of the organization's software process.

Appraisal method developers should consider the following factors in developing guidance for determining an appraisal's CMM scope:

- *The relationship between CMM scope and the ability to provide ratings.* An appraisal team cannot conclude that a specific KPA has been satisfied unless there has been an investigation of all goals for that KPA. Similarly, an appraisal team cannot conclude that a maturity level has been achieved unless there has been an investigation of all KPAs for that maturity level and all lower maturity levels. Without investigating all KPAs across a maturity level or all goals within a KPA, a team can only conclude that a maturity level has not been achieved or that a KPA is not satisfied.

- *The organization's software process maturity level.* The current maturity level of an organization's software process may impact the range of findings required. Suppose an appraisal is conducted for an organization with a level 2 process with the primary goal of providing input to action plans. Suppose further that the appraisal is limited to investigating only the KPAs at level 2. The organization would then not have the data required to develop comprehensive action plans for achieving level 3.
- *Constraints on appraisal length.* The more components of the CMM included in an appraisal's CMM scope, the greater the amount of time required to conduct the appraisal and report its results.

There may be areas outside of the CMM that the sponsor is interested in investigating and these areas are valid scoping considerations for the appraisal. Findings in these areas should be reported, but in no way should they affect the ratings of CMM components that are provided as a result of the appraisal.

3.3.1.2.2 Organizational Scope

Requirement: R5. A CAF compliant appraisal method shall provide guidance for choosing an appraisal's organizational scope.

Discussion: The appraised entity, or organizational scope of an appraisal, is the set of organizational units to which appraisal outputs apply. The sponsor's intended use of the appraisal results should drive the appraisal's organizational scope. For example, if the appraisal results are to be used for process improvement, then the organizational scope of the appraisal should match that of the intended improvement effort.

An appraised entity may be any portion of an organization, for example:

- An entire company.
- A selected business unit.
- A specific geographic site.
- Organizational units involved in producing software for a particular product line or application domain.
- Organizational units involved in providing a particular type software service such as maintenance or reengineering of legacy systems.
- A specific project.
- A team involving multiple companies.

The CAF does not require a method to impose any particular organizational constraints in terms of structure or location on the appraised entity. In writing this guidance, however, appraisal method developers should consider the following factors:

Management structure. The organizational units that make up an appraised entity may have management structures with varying degrees of overlap. For example, the appraised entity may consist of:

- A single business unit with one business unit manager,
- Multiple business units with managers who report to a single executive,
- A multi-company team with a project management structure that overlaps the management structures of each of the companies involved.

The extent to which the appraised entity shares a common management structure has an impact on the appraisal, specifically the ease of obtaining commitment to the appraisal process and the use of its results. If, for instance, the appraised entity includes multiple business units, both corporate and business unit managers may be involved in the initial appraisal planning process.

Impact of shared software processes. The extent to which the appraised entity's business goals support a shared or common software process also impacts the use of appraisal results. The organization may be involved in widely varying business areas. One area may focus on development of systems to support major business reengineering efforts while another may focus on maintenance of existing systems whose requirements undergo slow, incremental change. Differences in life cycles, tools, and techniques employed in each of these areas may reduce the amount of commonality in an organizational level software process that is beneficial. These differences may also increase the complexity of the tailoring guidance associated with a common process.

Organizational and project level responsibilities. The CMM identifies both organizational level and project level responsibilities for implementation of KPAs. An appraisal's data collection plan must take into account the extent to which the appraised entity includes units responsible for both project and organizational level practices. For example, the organizational scope of an appraisal may be a single project. It is still necessary to investigate those parts of the CMM that are primarily organizational level responsibilities, such as establishing policies, defining the organization's standard process, and maintaining the organization's software process assets.

Geographic dispersion. The extent to which the appraised entity is geographically dispersed impacts the time required to perform the appraisal and the ease with which the appraisal team can maintain its continuity. An appraisal represents a view of the appraised entity's software process at a point in time. Any appraisal that spans locations needs to be completed in the same time frame. In addition, since the entire appraisal team is involved in making judgments during an appraisal, the same team should participate in the appraisal activities at each location. If a method permits different team members for appraisals which span locations then the method needs to address management of risks associated with making consistent team judgments.

3.3.1.3 Establish Commitments

Requirement: R6. A CAF compliant appraisal method shall provide guidance for obtaining an organization's commitment to proceed with the appraisal process.

Discussion: An organization's commitment to perform an appraisal is essential to the ability of the appraisal team to produce useful results. Having senior management support is crucial for the conduct of the appraisal and any follow-on activities.

In providing guidance for the commitment process, appraisal method developers should consider the following factors:

- *The sponsor's commitment.* An appraisal sponsor is the individual for whom an appraisal is done and may be within the organization or outside of the organization. If an appraisal process is to produce results which meet its sponsor's goals, then the sponsor and the appraisal team must develop a mutual understanding of those goals and any associated appraisal constraints,
- *Senior site manager's commitment.* The sponsor of an appraisal may or may not be the senior manager in charge of the appraised entity. If they are different individuals, the process of obtaining a commitment to perform the appraisal should involve both the appraisal sponsor and the appraised entity's senior manager.

3.3.2 Select and Prepare Team

Selecting and preparing an appraisal team involves identifying the appraisal team leader, selecting each of the team members, and providing the team with training and orientation needed to prepare for the appraisal.

3.3.2.1 Team Qualifications

Requirement: R7. A CAF compliant appraisal method shall document appraisal team qualification criteria that conform at a minimum to the following technical and management experience requirements:

- At least five years of technical experience for the majority of the team members.
- At least twenty five years of technical experience for the team as a whole.
- At least six years of management experience for one team member.
- At least ten years of management experience for the team as a whole.

Discussion: The composition of the appraisal team has a great impact on the success of an appraisal. Appraisal team selections must ensure that the team's combined knowledge, experience, and skills are appropriate for the type of appraisal as well as the domain and expected maturity level of the appraised entity.

At the same time, individuals who have a vested interest in the results should not be selected for the appraisal team as their objectivity could be an issue and the focus of the appraisal may be more on rating considerations than identifying weaknesses. It is, however, desirable to have someone from the organization on the appraisal team.

An appraisal team needs to make judgments. The more experience the team members have, the more likely they are to make consistent judgments. Both technical and management experience are important to making judgments. The breadth of this experience in terms of an appraised entity's life cycle activities is also important.

For a team to execute an appraisal method effectively, each team member must be trained in the method. In addition, the appraisal team leader must have experience in using the method.

The team should also have knowledge about the appraised entity's domain and environment, and it is useful to have someone from the organization on the team. On the other hand, information on the environment and the domain could be supplied to the team as part of an appraisal specific orientation.

In addition to providing appraisal team qualification criteria, appraisal methods should address the waiver procedures. Team qualification criteria may involve, for example, training that is unnecessary for people with particular experience. Waiver procedures allow sponsors and appraisal team leaders flexibility in selecting appraisal team members.

Requirement: R8. A CAF compliant appraisal method shall specify the qualifications of the team leader that at a minimum include experience in using the appraisal method, managing teams, facilitating group discussions, and making presentations.

Discussion: The appraisal team leader needs the same set of skills as the appraisal team members. In addition, the leader must be an effective presenter, facilitator, and manager or must work with a coach who can supplement his/her skills. Sound presentation skills are needed to carry out orientation, training, and reporting activities. Facilitation skills are needed to ensure full participation in activities that require broad organizational participation as well as those that require team judgment. Management skills are required to plan the appraisal and to manage its execution.

3.3.2.2 Team Size

Requirement: R9. A CAF compliant appraisal method shall provide guidance for determining appropriate team size.

Discussion: Team size affects the accuracy of appraisal results. Teams may be too small to address the full scope of an appraisal within the allotted time frame. On the other hand, teams may be too large to reach consensus quickly and efficiently in the team judgment process.

Observers may further impact the efficiency with which an appraisal team can conduct appraisal activities. Appraisal method developers should provide guidance for allowing or disallowing observers to participate in the appraisal process. If observers are allowed, the guidance should define the role of appraisal observers, clearly identify constraints on their participation in the appraisal process, and establish limits on their numbers.

3.3.2.3 Team Preparation

Requirement: R10. A CAF compliant appraisal method shall provide guidance for preparing an appraisal team to conduct an appraisal, including applying the CMM.

Discussion: An appraisal team requires knowledge of the conduct of the appraisal as well as of the CMM and the appraised entity. Without this knowledge the team cannot effectively evaluate the entity's software process using the CMM as a framework. Team members need sufficient knowledge to be able to explain the overall structure of the CMM, the interrelationships between and among KPAs, and relate the CMM to the appraised entity's software processes.

In preparing an appraisal team to perform a specific appraisal, the team leader should consider the following factors:

- *Team building.* Team members must work effectively as a group in order to complete the appraisal process in the allotted time frame. The appraisal method should provide adequate team building opportunity during the appraisal planning and preparation process. Team building might be achieved through joint training sessions or joint activities such as scripting questions for interview sessions.
- *Training.* One way to close the gap between team experience and the appraisal method's minimum team qualifications is to provide training following team selection. For example, the appraisal method might provide guidance for training the team in the CMM or in the method's application.
- *Appraisal Specific Orientation.* Appraisal teams that are introduced to the appraised entity's way of doing business prior to the appraisal may be more effective in the appraisal process. For example, an understanding of the entity's terminology, life cycle, application domain, and environment helps appraisal team members phrase questions in ways that are meaningful to appraisal participants.
- *Appraisal Plan Review.* The appraisal team must understand and be prepared to execute the appraisal plan. The appraisal method should provide mechanisms for achieving this understanding. For example, the method could include an appraisal plan review activity or could involve team members in the planning process itself.

3.3.3 Select and Prepare Participants

Appraisal participants are those people who provide the appraisal team with data concerning the appraised entity's software process. Selecting and preparing an appraisal's participants involves:

- Identifying the particular sites, projects, and organizational support units from which participants will be drawn.
- Identifying the specific individuals who will participate in an appraisal's data collection activities.
- Providing these individuals with an orientation in the appraisal process.

An appraised entity may span one or more geographic locations or sites. Its software development and maintenance activities may be organized into one or more projects. Additional organizational units, such as software process engineering or training groups, may provide support to these projects in accomplishing their activities as well as other projects outside the scope of the appraised entity. An appraised entity's people may have affiliations with one or more of its projects or support units.

3.3.3.1 Select Sites

Requirement: R11. A CAF compliant appraisal method shall provide guidance for site selection.

Discussion: A site is a single geographic location. The appraised entity may span multiple sites. The sites selected to participate in appraisal data collection activities should be representative of the appraised entity so that appraisal results provide an accurate picture of the appraised entity's software process.

3.3.3.2 Select Projects

Requirement: R12. A CAF compliant appraisal method shall provide guidance for project selection.

Discussion: A project is a software development or maintenance effort that may have a specific process, budget, schedule, and set of work products. The appraised entity will typically be responsible for multiple projects. An appraisal may focus its data collection activities on a subset of the appraised entity's projects. If these projects are representative of the appraised entity, appraisal results are more likely to provide an accurate picture of the appraised entity's software process. The projects selected should be an appropriate cross section with respect to factors such as type, size, and life cycle phase.

Some questions the appraisal method developers should consider in developing project selection guidance include:

- Do the projects have a major impact on achieving the organization's financial goals?
- Do the projects have strategic importance to the organization?
- Do the projects use technology that is currently prevalent in the organization?
- Do the projects reflect current practice in each of the organization's life cycle phases?
- Are significant differences anticipated in the maturity of individual projects' software processes? If so, what impact will these differences have on the organization's intended use of appraisal outputs?

3.3.3.3 Select Individual Participants

Requirement: R13. A CAF compliant appraisal method shall provide guidance for participant selection.

Discussion: Participants in appraisal data collection activities need to be representative of the entity being appraised. If participants are representative of the appraised entity, then the appraisal results are more likely to provide an accurate assessment of the appraised entity's software process capability. The appraisal method developers should take into account the extent to which selection guidance supports a participant population that reflects:

- *The size of the appraised entity.* The percentage of an appraised entity's people who participate in an appraisal has an impact on the appraisal results. If the appraised entity is small, it may be possible for all of its people to participate in the appraisal. If everyone participates the risk of selecting a set of non-representative set of appraisal participants is non-existent. Normally, however, only a percentage of the people affiliated with an appraised entity can participate in an appraisal. As this percentage decreases, the risk of a non-representative set of appraisal participants increases.
- *The breadth of the appraised entity.* At a minimum, an appraisal should include participants from the sites and projects selected to participate in the appraisal. It should also include participants from organizational level units (such as software process engineering and training groups) that provide support to these sites and projects in carrying out their activities.
- *The characteristics of the appraised entity's population.* The characteristics of the appraisal participant population should resemble those of the appraised entity as a whole. If the appraised entity includes a small percentage of very experienced people, then the appraisal participants should also include only a small percentage of very experienced people.
- *A detailed understanding of the appraised entity's software development and maintenance activities.* The appraisal participants, as a group, should have detailed knowledge of the appraised entity's software development and maintenance activities. They should also be aware of current problems in the procedures used to perform these activities.

Organizational units other than projects, such as software engineering process groups or organizational level training groups, may contribute to a project's software development and maintenance efforts. These units may be part of the appraised entity or part of the larger organization that encompasses the appraised entity. Appraisal method developers need to provide guidance on how members of such units will participate in the appraisal process.

3.3.3.4 Orient Participants

Requirement: R14. A CAF compliant appraisal method shall provide guidance for appraisal participant orientation.

Discussion: Participants who understand the appraisal goals, its planned activities, and the anticipated use of its results will be able to contribute more effectively to the appraisal process. An appraisal method may employ a variety of methods, such as briefings or announcements, to acquaint participants with appraisal plans. These preparatory activities may be targeted at the appraisal participants alone, or the entire organization affected by appraisal results.

In providing orientation guidance, appraisal method developers should consider such factors as:

- The relationship between the appraisal sponsor and the appraised entity.
- Their level of understanding of process improvement concepts.
- Their level of CMM knowledge.
- The appraised entity's prior appraisal experience.
- The success and/or failure of its previous process improvement efforts.

3.3.4 Develop Appraisal Plan

Requirement: R15. A CAF compliant appraisal method shall provide guidance for developing and documenting an appraisal plan that, at a minimum:

- Identifies the appraisal goals.
- Identifies the appraisal scope.
- Identifies the appraisal activities.
- Provides a schedule for the activities.
- Identifies the people, resources and budget required to perform the activities.
- Identifies the appraisal outputs and their anticipated use.
- Identifies anticipated follow-on activities.
- Documents any planned tailoring of the appraisal method and associated trade-offs.
- Identifies risks associated with appraisal execution.

Discussion: The appraisal plan provides a means to set expectations concerning the appraisal process. During the planning phase, the appraisal sponsor and the appraisal team leader must come to a common understanding of the appraisal process and its anticipated outcome. An appraisal plan, when complete and documented, should communicate this understanding.

The appraisal method developers need to consider addressing the following topics in providing guidance for developing and documenting an appraisal plan:

- Appraisal plan contents.
- Review and approval of the appraisal plan.
- Communication of the plan to appraisal team and participants.
- Circumstances under which the plan should be updated.
- Mechanisms for review, approval, and communication of updates.

The appraisal plan should identify and document choices that may impact the accuracy and completeness of appraisal results. The following are potential factors that should be considered:

- CMM scope of the appraisal.
- Organizational scope of the appraisal.
- Selected sites, projects, and participants.
- Selected team members, team size, and participation of observers.
- Planned CMM coverage.
- Appraisal schedule, particularly time allotted for appraisal conduct.
- Availability of resources.
- Tailoring of the appraisal method.

The probability of achieving appraisal goals is related to the choices made by the appraisal sponsor and the appraisal team leader in the planning process. By documenting the choices, the appraisal sponsor and appraisal team leader should have a mutual understanding of their potential impact on the success of the appraisal. Sections 3.3 and 3.5.1 include a discussion of the trade-offs that should be considered in the appraisal planning process with respect to each of the factors listed above.

3.3.4.1 Determine Time Required to Conduct Appraisal

Requirement: R16. A CAF compliant appraisal method shall provide guidance for determining the amount of time required to conduct an appraisal.

Discussion: The time spent in conducting the appraisal (collecting data, consolidating it, making judgments, and producing appraisal outputs) affects on the cost of the appraisal, the amount of its disruption to the appraised entity, and the quality of the appraisal outputs. These effects need to be considered in scheduling appraisal activities, particularly those that involve the appraised entity's participants.

The scope of the appraisal further influences the balance that can be achieved among appraisal quality, cost, and disruption. The greater the size and breadth of the appraised entity, the more time required to achieve confidence in appraisal output. The more KPAs included in the appraisal, the more time required as well.

3.3.4.2 Work Out Logistics

Requirement: R17. A CAF compliant appraisal method shall provide guidance for appraisal logistics.

Discussion: Appraisal methods should provide appropriate logistics guidance so logistics do not become a risk to the appraisal's execution. A variety of resources are required to conduct appraisal activities, such as labor, transportation, accommodations, facilities, tools, and supplies. Obtaining these resources requires commitment from the appraisal sponsor and, if different, the senior manager of the appraised entity. Scheduling these resources requires a certain amount of coordination among the appraisal team leader, the appraisal team members, and the appraised entity. Appraisal methods should provide appropriate guidance to facilitate these interactions.

3.3.4.3 Select Artifacts

Requirement: R18. A CAF compliant appraisal method shall define a set of artifacts to support the following appraisal activities:

- Recording observations.
- Categorizing observations (with respect to the CMM).
- Classifying observations (as strengths or weaknesses).
- Validating observations.
- Recording coverage.
- Making rating decisions.
- Reporting findings and ratings.
- Managing logistics.

Discussion: Forms, templates, and checklists for appraisal activities help the team carry out the appraisal. They also serve as a record of the appraisal conduct. This record provides information that may be useful in assessing the effectiveness of the appraisal method. This record may also provide a level of detail that is valuable to an appraisal team involved in developing action plans. It may include information that is not, for confidentiality reasons, shared outside the team or included in the appraisal reports.

3.4 Conduct Appraisal

As illustrated in Figure 3-3, conducting an appraisal focuses on:

- Collecting and recording data in the form of notes.
- Consolidating data into a manageable set of observations, determining their validity as findings, and their coverage of the appraisal scope.
- Using those findings to produce ratings of the appraised entity's software process with respect to the CMM.

The appraisal conduct phase results in a set of appraisal outputs which include both findings and ratings.

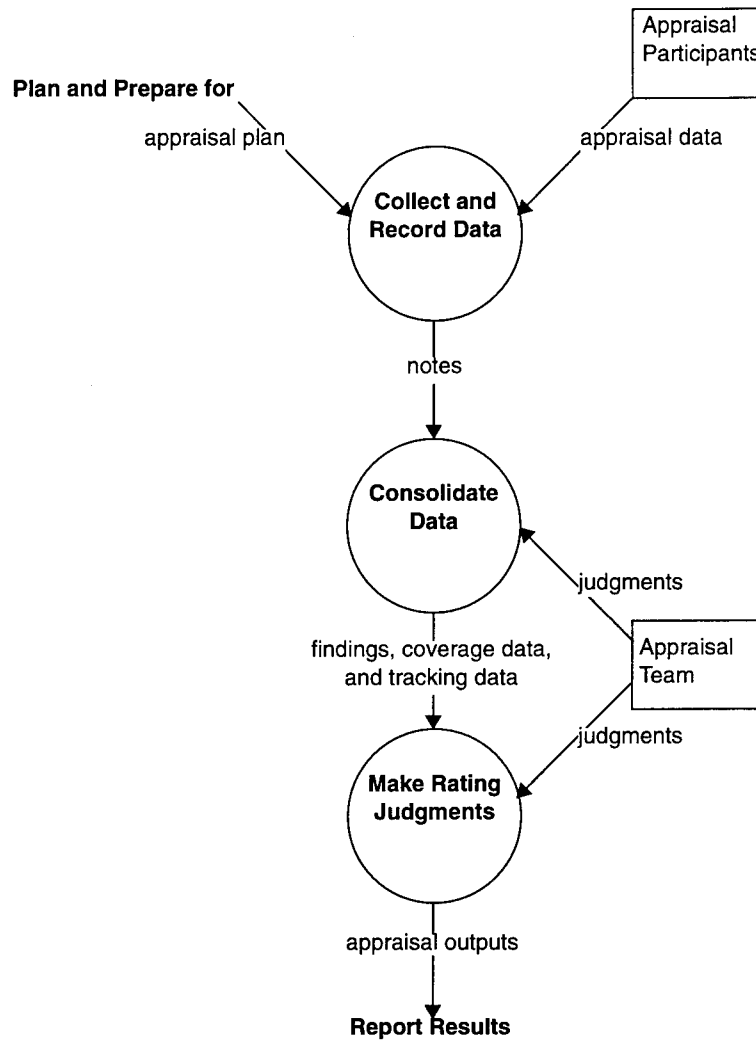


Figure 3-3: Conduct Appraisal

3.4.1 Collect and Record Data

Requirement: R19. A CAF compliant appraisal method shall provide guidance for implementing data collection techniques to be used in conducting an appraisal and classify them with respect to the following four categories:

- Administering instruments.
- Conducting presentations.
- Conducting interviews.
- Reviewing documentation.

Discussion: The various sources of appraisal data fall into one of the following four categories:

- Instruments

- Presentations
- Interviews
- Documents

Data collection using instruments includes such activities as administering questionnaires and surveys and gathering their responses. These activities may or may not involve a direct interface between the appraisal team and the appraisal participants. The things that distinguish instruments from other data collection mechanisms are the formal, written nature of the information requested and the fact that the people responding have some time to prepare the response.

Data collection using presentations can involve presentations by the appraisal team or the appraisal participants that include interaction between the two. Generally, presentations involve displaying or demonstrating information about a predetermined set of topics to an audience. They may allow appraisal participants to provide process and product data to the appraisal team or the appraisal team to solicit feedback from the appraisal participants. The structure of a presentation usually restricts the amount of interchange between the audience and the presenters to defined topics and periods of time.

Data collection through interviews involves appraisal team members asking questions and engaging in discussions with appraisal participants and recording their responses. Discussions among appraisal participants facilitated by the appraisal team also fall into the category of interviews. Varying numbers of appraisal team members and participants may participate in such sessions. Participants can include managers or technical staff. They may be people responsible for performing work as well as people responsible for managing work performance. People can fall into both categories. For example, a manager may oversee the work performed by his/her staff and still be responsible for directly generating certain products such as plans and status reports.

Data collection using documents involves reviewing a lasting representation of information. Documents may exist in various hardcopy or electronic forms such as bound books, loose leaf notebooks, slides, posters, word processor files, data bases, or electronic mail folders. These documents can include documents that specify how work is to be accomplished (directive documents) as well as documents that are records or products of the work performed. Examples of directive documents include such things as policies, procedures, plans, work instructions, standards, and checklists. Examples of work products include design documents, code, user manuals, and analyses of work records. Examples of work records include such things as status reports, meeting minutes, and action item lists. Documents may fall into multiple categories. For example, a project plan that specifies how the work to produce a particular system is to be performed is a work product of a planning activity. A configuration status report that provides a record of Configuration Control Board decisions may be a work product of the configuration management group.

Each of these data collection techniques has inherent strengths and weaknesses in terms of the value of data that they provide. Instruments are easy to replicate. They can allow participants the flexibility to research their answers and to respond when convenient. They can provide a means of comparing the responses of a large set of participants to the same set of questions. However, instruments do not provide much opportunity to eliminate misinterpretation. Respondents may misinterpret questions. The appraisal team may misinterpret answers.

Presentations can provide a large amount of information to a large group of people in a short period of time. Presentations provide more opportunity for appraisal team and appraisal participant interaction than instruments, but less than interviews. This interaction decreases the risk of misinterpretation, although the presenter may limit a presentation to only those things he/she chooses to communicate.

Interviews provide the opportunity to build rapport between the appraisal team and the appraisal participants. They have the potential to facilitate a rapid understanding of an appraised entity's software process. Appraisal teams can easily adjust the topics covered during interviews to probe areas of particular strength or weakness. Interviews, however, are hard to replicate. They can be intimidating. The appraisal team can have difficulty in accurately recording the information that they receive. The appraisal team may ask participants to describe activities that they do not actually perform themselves.

Documents can provide an objective source of information. Appraisal teams can obtain a large amount of information from documents if they are well organized and indexed. Documents, on the other hand, can provide too much data for the appraisal team to absorb in a short period of time. They also may be out of date or may have fallen into disuse.

The data collection techniques selected and the manner in which they are implemented affect the precision of the information they provide. For example, work products and work records would more likely represent work actually being performed as opposed to a directive document.

By incorporating a combination of data collection techniques in an appraisal, the appraisal team can increase the likelihood of knowing how work is actually performed. For example, an appraisal team that did all of the following should have a better idea of how work is being performed than a team that did less.

- Examines a work product.
- Talks to the person or people who produced it.
- Examines the plan that directed its production.

If the data is obtained from multiple sources and that data is consistent, then it is much more likely to accurately reflect the work being done and the processes implemented than data obtained from a single source.

3.4.2 Consolidate Data

As illustrated in Figure 3-4, consolidating data includes:

- Transforming notes from data collection sessions into a set of observations and categorizing them relative to the CMM.
- Determining that these observations are valid findings.
- Determining the extent to which the findings provide adequate coverage of the scope of the appraisal and adjusting data collection plans accordingly.
- Maintaining traceability among observations, findings, and ultimately ratings.

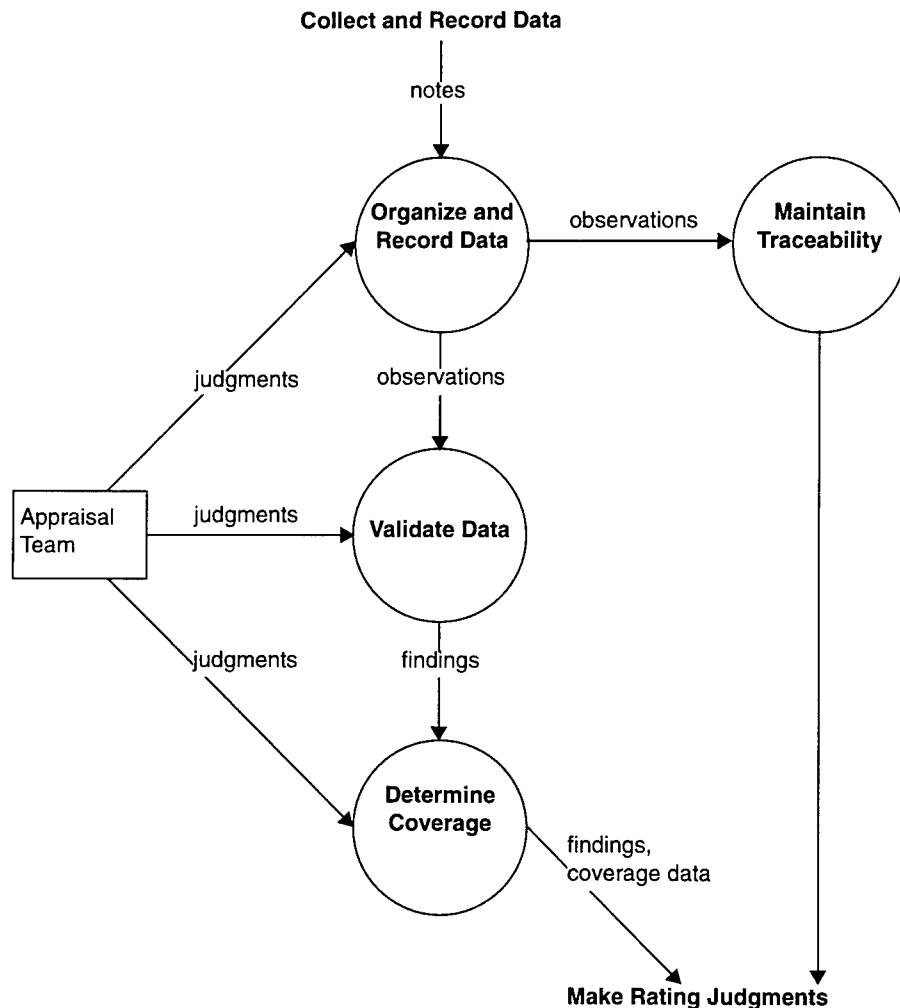


Figure 3-4: Consolidate Data

3.4.2.1 Organize and Record Data

Requirement: R20. A CAF compliant appraisal method shall provide guidance for consolidating the data collected during an appraisal that addresses at a minimum:

- Extracting information from data gathered during data collection sessions.
- Recording them as observations.
- Classifying the observations (e.g., as potential strengths or weaknesses).
- Categorizing the observations in terms of the CMM or categorizing them as non-CMM findings.

Discussion. The primary input to consolidation is notes. Notes are recordings of data collection sessions. They are generally produced by individual team members. Observations are information extracted by team members from individual notes and are an intermediate work product of consolidation. They should primarily represent information concerning an appraised entity's software process that describes its correspondence with CMM goals and key practices. They may also represent information concerning an appraised entity's software process that is unrelated to the CMM. The appraisal team needs to organize observations in a manner that facilitates their use in developing appraisal outputs, specifically findings and ratings.

The guidance for data consolidation should provide the criteria for transforming notes into observations. Appraisal method developers should consider the following factors in developing such guidance:

Wording. Valid observations are findings. Their wording is an important element of communicating with the appraisal participants. Clear observations phrased in terms familiar to the site will be readily understood. Observations that avoid use of absolutes such as "all" or "none" are less likely to be controversial. Observations that avoid attribution can be used directly in appraisal reports. Wordsmithing is appropriate to ensure the required confidentiality and to ensure that the meaning of an observation is correctly conveyed. Wordsmithing that changes the meaning of recorded data, or generalizes it without supporting evidence, should be avoided.

Observed basis. Observations should be based on what the appraisal team hears and sees directly and not on interpretations or conclusions of what they have heard and seen.

Relevance. Observations should be relevant to the scope of the appraisal. While an appraisal method may include information not directly related to the areas of the CMM being investigated, this should be a small amount of information. If the appraisal does not focus on data relevant to the initial scope of its investigation, reliability of the appraisal outputs with respect to the CMM decreases.

Significance. In order to reduce notes to a manageable set of observations, data that is not significant evidence concerning the appraised entity's software process strengths and weaknesses should not be recorded as observations. Generally significant data will take one of the following forms:

- Evidence of implementation of CMM key practices.
- Evidence of alternative practices which meet KPA goals.
- Evidence of software process strengths unrelated to the CMM.
- Evidence of absence of CMM key practices.

- Evidence of software process weaknesses unrelated to the CMM.
- Evidence of not applicable CMM practices.

Grouping. Another factor to consider in reducing notes to a manageable set of observations is the manner in which they are condensed. Observations may correspond to:

- A data item recorded in notes.
- A grouping of related data items.
- An abstraction or summary of related data items.

3.4.2.2 Validate Data

Requirement: R21. A CAF compliant appraisal method shall provide guidance for validating observations that includes corroboration of the observation by data obtained, at a minimum, from:

- Multiple and independent sources.
- Interviews or presentations that include people performing the related work or reviews that include documents that are products or records of that work.

Discussion: During consolidation, the appraisal team needs to validate the observations they have recorded to ensure that they accurately reflect the practices of the appraised entity. Findings are valid observations that the team carries forward for subsequent use in ratings and reports.

Validation should be performed at two levels: by the appraisal team and the appraised entity. Appraisal team members must come to consensus on the validity of their observations based on the data that they collect. In addition, the appraisal team should solicit feedback on these observations from the appraised entity. They can do this directly through such mechanisms as draft findings presentations or indirectly through such means as consolidation interviews designed to test their assumptions or both. In some applications, validation by the appraised entity may not be possible.

Validation guidance needs to address the manner in which the appraisal team corroborates observations. The rationale for the minimum guidance outlined above is as follows:

- Observations should come from multiple and independent sources to ensure that they do not reflect just one person's perspective concerning the appraised entity's processes. Participants in presentations and interviews may be biased by the comments others make; therefore, observations should also be supported by data from multiple data collection sessions.
- Observations should be confirmed by people performing related work or by documents that are the output or record of that work because:
 - Observations concerning a particular activity are more likely to be accurate if they are based on data provided by the people performing the activity rather than people managing or observing the activity from a distance.

- Observations concerning a particular activity are more likely to be accurate if they are based on a review of the activity's work product and work records rather than directive documents that indicate how the work should be performed.

In providing validation guidance, appraisal method developers should also consider the need to resolve conflicts that might arise between observations recorded by different appraisal team members. Conflicts might include:

- Evidence of weaknesses and non-applicability related to the same CMM practice.
- Evidence of weaknesses and alternative implementations associated with the same CMM practice.
- Evidence of weaknesses and strengths associated with the same CMM practice.

The conflicts might arise for a number of reasons such as:

- Team members may review different documents.
- Team members may make observations that the team later discovers pertain only to a subset of the appraised entity.
- Team members may record weaknesses prior to discovering that the related practices are not applicable in the organization's environment.
- Team members may record weaknesses prior to discovering that an acceptable alternative to a CMM practice has been implemented.

Requirement: R22. A CAF compliant appraisal method shall provide guidance for validating observations that requires at a minimum that a portion of the observations related to each of the KPA goals within the scope of the appraisal are supported by a review of related documentation.

Discussion: Please note that the key practices to goal mapping is shown in Appendix B. The key practices elaborate on the goals and provide guidance for interpreting them, but they are not mandated, as there may be alternative implementations that meet the goals' intent.

In order to ensure that the appraisal teams' perception of the appraised entity's practices is accurate, a significant portion of the observations should be confirmed by a review of documentation. It is a method specific implementation to specify that amount.

Review of documentation is primarily directed at identifying strengths as a lack of documentation is often a confirmation of a weakness.

The purpose of reviewing documentation is not limited to confirming existing observations. Observations can be generated based on document review, which would still need to be independently validated.

3.4.2.3 Determine Coverage

Requirement: R23. A CAF compliant appraisal method shall provide guidance for evaluating and documenting the sufficiency of findings relative to the scope of the appraisal, including coverage criteria that adhere to the following minimum set of rules for determining whether sufficient data exists to support rating:

- A goal is covered if sufficient findings exist to judge the extent of its implementation and institutionalization relative to the CMM, the appraised entity, and the appraised entity's life cycle(s) (including the existence of acceptable alternatives).
- A Key Process Area is covered if all of its goals are covered.
- A maturity level is covered if all of its Key Process Areas and all those of lower level KPAs are covered.

Discussion: Rigorous investigation of every key practice may not be feasible during the course of an appraisal. A CAF compliant appraisal method needs to establish sampling criteria for both the activities performed as well as the institutionalization common features. This may involve investigating every key practice, investigating a random percentage of key practices, investigating a specific subset of key practices, or some other criteria.

The reliability of an appraisal's outputs is directly related to the extent to which an appraisal's findings provide an adequate sampling of key practices and software process data related to the scope of the appraisal. This includes:

- Coverage of the components of the CMM selected for investigation.
- Coverage of the appraised entity.
- Coverage of the appraised entity's life cycle activities.

Appraisal method developers should consider the following factors in describing rules for gathering and analyzing coverage information:

Adequate CMM coverage. Satisfaction of a KPA depends on satisfaction of the goals. This satisfaction can involve implementation of the key practices that map to that goal as described in Appendix B or implementation of an alternative set of practices that achieve the goal. A CAF compliant method requires coverage of all of the goals that fall within the scope of the appraisal. A CAF compliant appraisal method requires a sampling of the appraised entity's key practices that map to each goal.

Adequate organizational coverage. During the appraisal planning process, a representative sample of sites, projects, and people are selected to participate in the appraisal. During appraisal conduct, it is incumbent upon the appraisal team to ensure that data actually collected covers each of these organizational entities. Documents related to each of the selected projects should be sampled. Data should be solicited from each of the appraisal participants. The appraisal team must be capable of facilitating full participation in group interview and presentation sessions.

Adequate life cycle coverage. Some software process activities are limited to particular phases of an appraised entity's life cycle, while others span multiple life cycle phases. The appraisal team must ensure that the data collected covers each of the life cycle activities in which the appraised entity is involved. The team may need to focus the topics explored during interviews, presentations, and document review on specific life cycle phases.

Extension to coverage rules. Appraisal method developers may choose to impose a more stringent set of rules for determining coverage. For example, an appraisal method might require that the findings related to each individual key practice cover all organizational units comprising the appraised entity or all applicable life cycle phases. Such extensions in coverage rules should be clearly related to the appraisal goals since they will lengthen the appraisal schedule and increase both the cost and disruption associated with the appraisal.

Recording Coverage Data. Coverage data quantifies the degree to which the appraisal team's findings map to or cover elements of the CMM, the appraised entity, and the associated life cycle activities that fall within the scope of an appraisal. Generally, the appraisal team will use coverage data to track progress towards their goal of developing a sufficient set of findings. The appraisal team must protect the confidentiality of this data. Appraisal reports may include only summaries of coverage data that do not indicate attribution of information to particular sources.

Requirement: R24. A CAF compliant appraisal method shall define mechanisms for adjusting data collection plans to obtain sufficient coverage.

Discussion: CAF compliant appraisal methods involve multiple data collection sessions. Adjustments to the schedule for such sessions may be necessary in order to obtain sufficient coverage of the appraisal's scope. These adjustments can occur for any number of reasons. Participants in a given interview may not have the responsibilities or knowledge of activities assumed by the appraisal team. The appraisal team may not complete interviews in the allotted time frame. The questions asked may not provide the depth of information required to understand the extent to which a particular practice is implemented.

3.4.2.4 Maintain Traceability

Requirement: R25. A CAF compliant appraisal method shall provide guidance for recording traceability between the data collected during the appraisal and the appraisal outputs.

Discussion: Traceability allows the appraisal team to determine the source of the data on which its intermediate and final work products are based. Tracking data may be critical to resolving questions that arise during team discussions regarding consolidation or rating. It may also be necessary to evaluate feedback provided during presentations or to resolve questions about the final reports. It may be useful in subsequent action planning. Without such data it may be difficult for the appraisal team to explain and discuss findings and recommendations with the appraised entity.

Tracking data, however, allows individuals to attribute appraisal findings and ratings to information provided by specific people, projects, and sites. The appraisal team must protect the confidentiality of this data. While it provides a resource to the appraisal team that allows them to conduct their appraisal efficiently, it generally cannot be shared outside the team. Exceptions to this general rule may include appraisals that by agreement of the appraisal team leader, sponsor, and senior site manager(s) produce project or site specific findings. Such appraisals must still avoid attribution of findings to data provided by specific people. Appraisal teams may elect to destroy their notes after the appraisal to further protect the confidentiality of the appraisal participants who provided the data and retain only the data that is non-attributable.

Tracking data should show the correspondence among appraisal data sources, observations, findings, and ratings. This data can be recorded using pointers, references, traceability matrices, or other simple record keeping methods. The appraisal team should be capable of recording this data with minimal effort and time. Table 3-1 shows an example of a simple traceability matrix.

Rating	Finding	Observation	Session	Source
Rating 1	Finding 1	Observation y	Document review	Document 1, pg 12
			Interview 1	Document 2, pg 15
			Interview 6	Software engineer 2
	Finding 2	Observation x	Interview 2	Project manager 2
			Interview 8	Software designer 2

Table 3-1: Sample Traceability Matrix

3.4.3 Make Rating Judgments

3.4.3.1 Rated Components

Requirement: R26. A CAF compliant appraisal method shall require rating of the following categories of CMM components provided they fall within the scope of the appraisal:

- KPAs
- Goals

Discussion: Figure 3-5 illustrates the rated components within the structure of the CMM. There are three components of the CMM reference model that can be rated: goals, KPAs, and maturity level. Maturity level ratings are optional, since the rating itself provides minimal visibility into the state of an appraised entity's software process. However, all goals and KPAs within the appraisal scope should be rated. Appraisal method developers may choose to extend the rating scheme and rate common features and/or key practices.

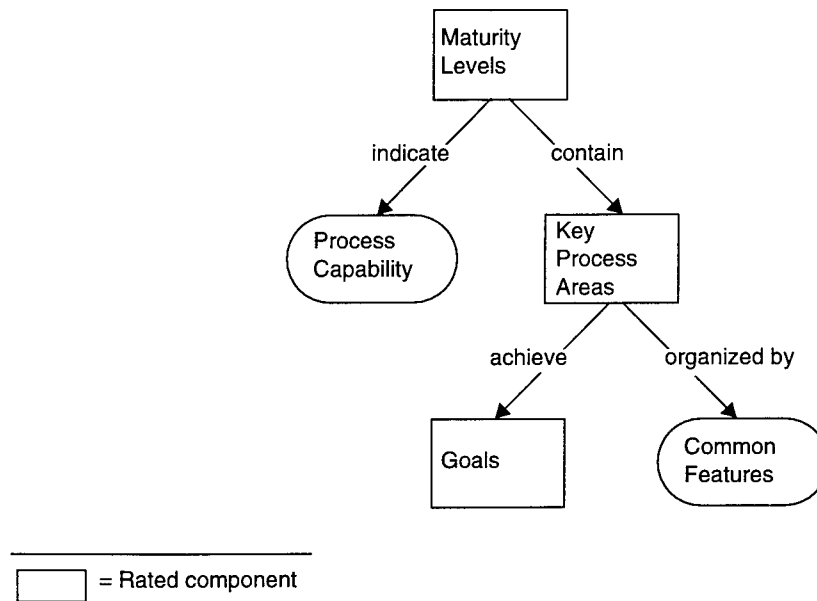


Figure 3-5: Rated Components Within the Structure of the CMM

3.4.3.2 Rating Scale

Requirement: R27. A CAF compliant appraisal method, if it calculates a maturity level rating, shall require that the maturity level rating is consistent with the five level scale provided in the CMM.

Discussion: The maturity level rating scale consists of five integral levels (1 - 5) as described in the CMM.

Requirement: R28. A CAF compliant appraisal method shall define a rating process using the following rating values:

- A KPA or goal is satisfied if this aspect of the CMM is implemented and institutionalized either as defined in the CMM, or with an adequate alternative.
- A KPA or goal is unsatisfied if there are significant weaknesses in the appraised entity's implementation or institutionalization of this aspect of the CMM, as defined, and no adequate alternative is in place.
- A KPA or goal is not applicable if the KPA is not applicable in the organization's environment.
- A KPA or goal is not rated if the associated appraisal findings do not meet coverage criteria or if this aspect of the CMM falls outside the scope of the appraisal.

Discussion: Four rating values are provided for goals and KPAs: satisfied, unsatisfied, not applicable, or not rated. If a KPA is determined to be not applicable in the organization's environment, then all of the goals for that KPA are deemed not applicable. Conversely, if a KPA is determined to be applicable in the organization's environment, then all of the goals for that KPA are applicable.

Appraisal method developers may add additional ratings such as partially satisfied, to this rating scale. A partially satisfied rating maps to not satisfied on a satisfied/not satisfied rating scale.

3.4.3.3 When Ratings Can Be Performed

Requirement: R29. A CAF compliant appraisal method shall define a rating process which specifies that:

- An appraisal team can rate a goal when valid observations related to the goal meet the method's defined coverage criteria.
- An appraisal team can rate a KPA when it has rated each of the associated goals.
- An appraisal team can determine a maturity level rating once it has rated all of the KPAs within that level and each level below.

Discussion: The appraisal team develops ratings by making judgments based on the data that they collect during the appraisal process. The appraisal team's findings relative to a component of the KPA must meet that component's coverage criteria (see Section 3.4.2.3) in order for an appraisal team to provide the component rating. It should be rare that an appraisal team does not get sufficient data to be able to derive a rating. The team must make every effort to acquire sufficient data. However, it is better for an appraisal team to conclude without a rating than to derive one with insufficient data.

As illustrated in Figure 3-6, ratings are determined in a hierarchical fashion.

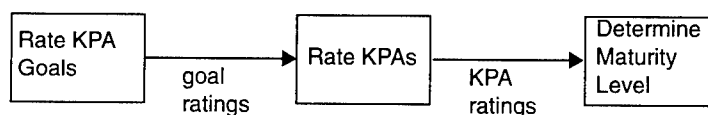


Figure 3-6: Rating Sequence

The rating of any given CMM component is dependent on ratings of the more detailed CMM components, if any. In particular:

- Maturity level ratings depend exclusively on KPA ratings. For example, rating of maturity level 3 requires that all KPAs within levels 2 and 3 be satisfied or not applicable.
- KPA ratings depend on the ratings of the goals. An appraisal team cannot rate a KPA satisfied if any goals are unsatisfied.

3.4.3.4 Rating Algorithm

Requirement: R30. A CAF compliant appraisal method shall define a rating process that requires full participation of all appraisal team members in reaching consensus in all rating decisions.

Discussion: The appraisal team must come to consensus on the ratings that it provides to an appraised entity. This consensus is one step in assuring that the entire team supports the appraisal report. Without consensus, the appraisal team cannot expect the appraised entity to have a high level of confidence in the contents of the report.

Requirement: R31. A CAF compliant appraisal method shall require that ratings be based on the CMM as defined in *Capability Maturity Model for Software, Version 1.1* [Paulk 93a] and *Key Practices of the Capability Maturity Model, Version 1.1* [Paulk 93b].

Discussion: All ratings must be based on the CMM and only on the CMM. A CMM-based appraisal, by definition, is using the CMM as a framework for evaluating an appraised entity's software process. The appraisal team must, therefore, maintain fidelity to the model in its rating process. An appraisal method cannot add new KPAs to the model or delete existing KPAs.

Requirement: R32. A CAF compliant appraisal method shall define a rating process that requires appraisal teams to base ratings on their findings (observations that they have validated).

Discussion: Ratings must be based on the data the appraisal team collects during the appraisal process. By basing ratings on findings that have been validated by the team, and directly or indirectly by the appraised entity, the appraisal team can achieve a high level of confidence in their accuracy.

3.4.3.4.1 Judge Satisfaction of Goals

Requirement: R33. A CAF compliant appraisal method shall define a rating process which specifies that each goal is rated in accordance with the following rules:

- Rate the goal "satisfied" if the associated findings indicate that this goal is implemented and institutionalized either as defined in the CMM with no significant weaknesses or that an adequate alternative exists.
- Rate the goal "unsatisfied" if the associated findings indicate that there are significant weaknesses in the appraised entity's implementation and institutionalization of this goal as defined in the CMM and no adequate alternative is in place.
- Rate the goal "not applicable" if the KPA is not applicable in the organization's environment.
- Rate the goal "not rated" if the associated findings do not meet the method's defined criteria for coverage or if the goal falls outside of the scope of the appraisal.

Discussion: The CMM is a framework with defined but not prescribed practices. CMM specified key practices may not be applicable in the context of an appraised entity's business. It is also possible that the appraised entity has implemented an alternate set of practices that achieve the intent and purpose of the associated KPA goals.

Furthermore, it is unlikely that an appraised entity will implement all CMM key practices and subpractices on all projects all of the time. Weaknesses in the implementation of CMM practices may or may not be significant when looking at the appraised entity as a whole. However, for a rating of "satisfied," if there are identified weaknesses they would have to be judged insignificant in achieving the KPA goal.

3.4.3.4.2 Judge Satisfaction of KPAs

Requirement: R34. A CAF compliant appraisal method shall define a rating process which specifies that each KPA is rated in accordance with the following rules:

- Rate the KPA "satisfied" if all of the goals are rated "satisfied."
- Rate the KPA "unsatisfied" if any goal is rated as "unsatisfied."
- Rate the KPA "not applicable" if the KPA is not applicable in the organization's environment.
- Rate the KPA "not rated" if any of the goals are rated "not rated" or if the KPA falls outside of the scope of the appraisal.

Discussion: Satisfaction of KPAs is based solely on the satisfaction of the goals. If any one of the goals is not satisfied, the KPA is automatically not satisfied.

3.4.3.4.3 Determine Maturity Level

Requirement: R35. A CAF compliant appraisal method shall define a rating process which specifies that maturity level, if determined, is determined in accordance with the following rules:

- A maturity level is satisfied if all KPAs within that level and each lower level are satisfied or not applicable.
- The maturity level rating is that of the highest maturity level satisfied.

Discussion: The appraisal team bases maturity level ratings solely on the KPA ratings. No additional team judgments are required.

3.5 Report Results

As illustrated in Figure 3-7, the Reporting Phase of an appraisal involves:

- Reporting appraisal results to sponsors, the appraisal method owner, the SEI, and, optionally, the appraised entity.
- Preserving appraisal records.

Protecting confidentiality of appraisal data is an important aspect of both of these activities.

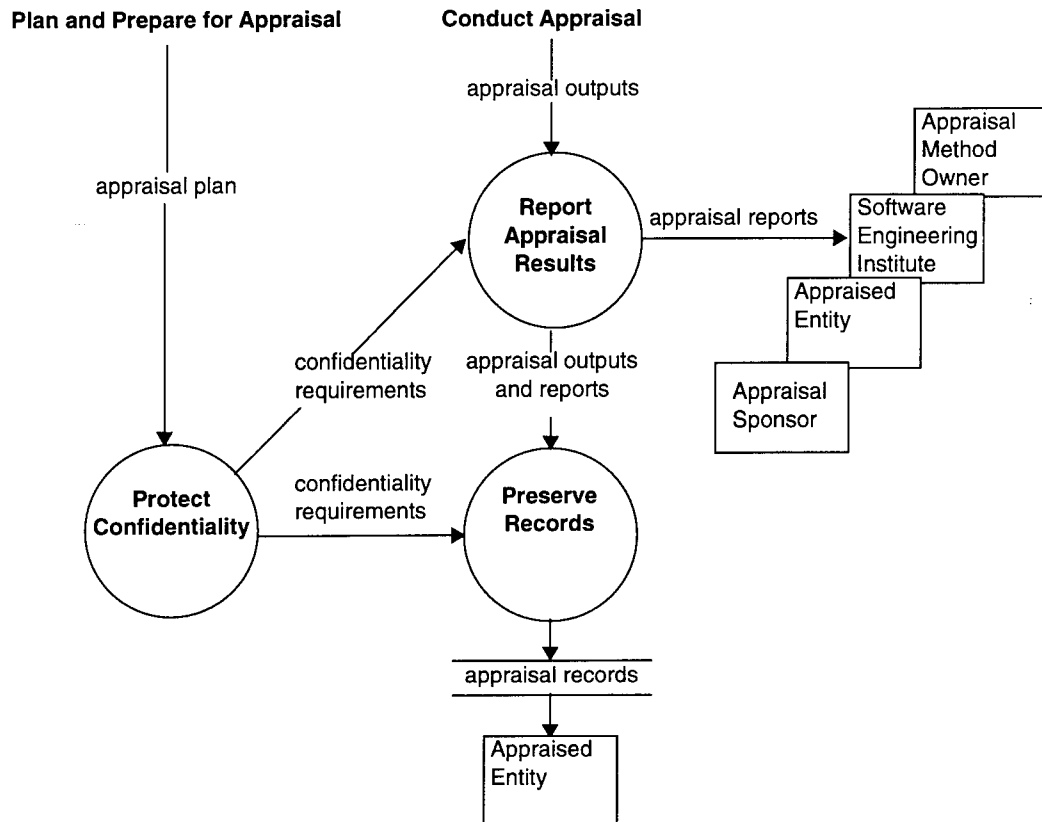


Figure 3-7: Report Results

3.5.1 Report Appraisal Results

Requirement: R36. A CAF compliant appraisal method shall identify the reports that the appraisal team provides as the result of the appraisal process.

Discussion: Appraisal methods should specify the types of reports that the appraisal team should provide based on the appraisal goals. At a minimum these should include reports to sponsors and the SEI. Every CAF compliant appraisal method should report the results to the appraised entity for use in process improvement; however, there may be instances when this is not feasible. If the appraisal method was developed outside of the SEI, a report of the appraisal conduct should be provided to the method owner.

Requirement: R37. A CAF compliant appraisal method shall require that the appraisal team report the following data, at a minimum, to the sponsor:

- Appraisal scope.
- Appraisal selections (site, projects, participants, team members).
- Findings.

- Ratings.
- Risks associated with the accuracy and completeness of appraisal outputs.

Discussion: Reports to sponsors include a restatement of the appraisal scope in order to identify the domain to which the findings and ratings are applicable. They include a description of the selections made during appraisal planning in order to provide an understanding of the breadth and depth of the data provided by the appraisal and the qualifications of the appraisal team. Findings and ratings are included, of course, since they are the primary output of the appraisal process and the data that forms the basis for follow-on activities. The appraisal report should identify the activities that will follow an appraisal and the manner in which they will use appraisal outputs. Appraisal teams need to understand the relationship between the appraisal and anticipated follow-on activities so that they provide the data required to implement the follow-on activities. They also need to ensure that actions taken during the appraisal process facilitate rather than impede the effectiveness of follow-on activities.

Appraisal outputs may be a significant factor in the decisions made by appraisal sponsors and/or appraised entities. They may result in selection of one software supplier over another. They may guide the areas in which an organization focuses its software process improvement efforts. Inaccurate findings may lead to inappropriate business decisions. Incomplete findings may result in lost opportunities to address significant areas of weakness or build on significant areas of strength.

While there are many different risk factors that impact the accuracy and completeness of appraisal outputs, SEI experience with existing appraisal methods indicates that the factors identified below are key.

- *Appraisal scope.* Factors associated with an appraisal's scope are identified in Section 3.3.1.2 and include those associated with selecting an appraisal's CMM scope as well as its organizational scope.
- *Appraisal team.* Factors associated with team selection are described in Section 3.3.2 and include those associated with team qualifications, size, the use of observers, and the objectivity of the team.
- *Appraisal sample.* Factors associated with selecting sites, projects and participants are addressed in Section 3.3.3 and include those associated with obtaining a representative sample of sites, projects, organizational support units, and people to participate in the appraisal process as well as the appraisal participants being entirely forthcoming.
- *Adequate coverage.* Factors associated with obtaining adequate coverage of the appraisal scope are discussed in Section 3.4.2.3 and include those associated with coverage of CMM, the appraised entity, and the entity's life cycle(s). In particular, there may be risks with sampling CMM components as opposed to obtaining full coverage, and the actual coverage of CMM components should be reported.

- *Validation of data.* Factors associated with validating findings are described in Section 3.4.2.2 and include those associated with corroboration of appraisal team observations as well as risks associated with eliciting feedback regarding these observations from the appraised entity.
- *Appraisal constraints.* Factors associated with appraisal constraints—schedule, cost, and disruption—are discussed in Section 3.3.4.1.
- *Adherence to appraisal method guidance.* Appraisal plans must be developed to conform to an appraisal method's guidance. Teams must successfully execute these plans. Deviations from appraisal method guidance and/or appraisal plans can have a significant impact on appraisal outputs.

Risks associated with the accuracy and completeness of appraisal outputs are primarily influenced by three things:

- The choices made by method developers in implementing a CAF compliant appraisal method.
- The choices made by the appraisal sponsor and appraisal team leader in planning an appraisal.
- The extent to which the appraisal team adheres to the appraisal plan.

Reports provided to the sponsor must observe the level of confidentiality agreed to for this appraisal. Any additional distribution of these reports is made solely at the discretion of the sponsor, including distribution to members of the appraised entity.

Requirement: R38. A CAF compliant appraisal method shall report appraisal results to the SEI.

Reports to the SEI provide information required to determine the state of software process industry-wide and to improve the CMM. This information should include appraisal plans and reports, details concerning interpretation of the CMM, applicability of its practices, and the existence of acceptable alternative practices.

The report should additionally provide information required to improve appraisal methods such as descriptions of appraisal method problems, suggestions for improvements, and information regarding tools that automate appraisal processes. If the method was developed outside of the SEI, this additional information should also be provided to the method owner.

3.5.2 Protect Confidentiality

Requirement: R39. A CAF compliant appraisal method shall provide guidance for protecting the confidentiality of appraisal information.

Discussion: In providing guidance for protecting the confidentiality of appraisal information, method developers should consider the following factors:

- *Attribution in appraisal reports.* In planning and preparing for an appraisal, the appraisal sponsor and appraisal team leader agree on the degree of attribution allowed in appraisal results. Attribution to individuals is not allowed since it would significantly impact the risks associated with obtaining complete and accurate data. Attribution to sites and projects may be allowed with agreement of site and project managers depending on appraisal goals.
- *Sharing of appraisal reports.* The appraisal team should not distribute reports to any party other than the appraisal sponsor and the SEI without the sponsor's permission. It may, for example, not be in the best interests of an organization to share data concerning its software process with competitors. Even distribution of reports to members of the appraised entity may have significant legal implications if the reports are related to appraisals performed to select software suppliers.
- *Informal communication of appraisal data.* Multiple people may participate in data collection activities. Information exchanged during those activities must be protected both by the appraisal team and by the appraisal participants. Appraisal records may be maintained for use in subsequent action planning. The appraisal team must take precautions to ensure use of these records does not violate the confidentiality agreements established during appraisal planning.

3.5.3 Preserve Records

Requirement: R40. A CAF compliant appraisal method shall provide guidance for retention of appraisal records.

Discussion: Appraisal method developers should consider the following factors in writing this guidance:

- *Purpose.* Appraisal records should only be preserved if they are likely to be used in post appraisal activities. For example, the appraisal plan and reports may be useful in conducting a subsequent appraisal even after a period of one or two years. More detailed records, such as notes, observations, findings, ratings, and associated tracking and coverage data may be required to permit a post appraisal audit for those appraisals that are components of acquisition activities. They may also be useful in the generation of detailed action plans.
- *Safeguards.* The confidentiality agreements established during the appraisal planning process remain in effect indefinitely. Appraisal records must be safeguarded to ensure that confidentiality is maintained.
- *Logistics.* The appraisal method should address the logistics associated with preserving appraisal data, controlling access to it, and disposing of it.

Appendix A Requirements

Requirement: R1. A CAF compliant appraisal method shall be documented, including at a minimum:

- Identifying the version of the CMM and the CAF on which it depends.
- Documenting the manner in which it has implemented appraisal method activities, artifacts and guidance required by the CAF.

Requirement: R2. A CAF compliant method shall provide guidance for three phases of appraisal execution:

- Plan and Prepare for Appraisal.
- Conduct Appraisal.
- Report Results.

Requirement: R3. A CAF compliant appraisal method shall provide guidance for:

- Identifying an appraisal's goals and constraints.
- Determining its suitability for the appraisal in light of those goals and constraints.

Requirement: R4. A CAF compliant appraisal method shall provide guidance for selecting an appraisal's CMM scope.

Requirement: R5. A CAF compliant appraisal method shall provide guidance for choosing an appraisal's organizational scope.

Requirement: R6. A CAF compliant appraisal method shall provide guidance for obtaining an organization's commitment to proceed with the appraisal process.

Requirement: R7. A CAF compliant appraisal method shall document appraisal team qualification criteria that conform at a minimum to the following technical and management experience requirements:

- At least five years of technical experience for the majority of the team members.
- At least twenty five years of technical experience for the team as a whole.
- At least six years of management experience for one team member.
- At least ten years of management experience for the team as a whole.

Requirement: R8. A CAF compliant appraisal method shall specify the qualifications of the team leader that at a minimum include experience in using the appraisal method, managing teams, facilitating group discussions, and making presentations.

Requirement: R9. A CAF compliant appraisal method shall provide guidance for determining appropriate team size.

Requirement: R10. A CAF compliant appraisal method shall provide guidance for preparing an appraisal team to conduct an appraisal, including applying the CMM.

Requirement: R11. A CAF compliant appraisal method shall provide guidance for site selection.

Requirement: R12. A CAF compliant appraisal method shall provide guidance for project selection.

Requirement: R13. A CAF compliant appraisal method shall provide guidance for participant selection.

Requirement: R14. A CAF compliant appraisal method shall provide guidance for appraisal participant orientation.

Requirement: R15. A CAF compliant appraisal method shall provide guidance for developing and documenting an appraisal plan that, at a minimum:

- Identifies the appraisal goals.
- Identifies the appraisal scope.
- Identifies the appraisal activities.
- Provides a schedule for the activities.
- Identifies the people, resources and budget required to perform the activities.
- Identifies the appraisal outputs and their anticipated use.
- Identifies anticipated follow-on activities.
- Documents any planned tailoring of the appraisal method and associated trade-offs.
- Identifies risks associated with appraisal execution.

Requirement: R16. A CAF compliant appraisal method shall provide guidance for determining the amount of time required to conduct an appraisal.

Requirement: R17. A CAF compliant appraisal method shall provide guidance for appraisal logistics.

Requirement: R18. A CAF compliant appraisal method shall define a set of artifacts to support the following appraisal activities:

- Recording observations.
- Categorizing observations (with respect to the CMM).
- Classifying observations (as strengths or weaknesses).
- Validating observations.

- Recording coverage.
- Making rating decisions.
- Reporting findings and ratings.
- Managing logistics.

Requirement: R19. A CAF compliant appraisal method shall provide guidance for implementing data collection techniques to be used in conducting an appraisal and classify them with respect to the following four categories:

- Administering instruments.
- Conducting presentations.
- Conducting interviews.
- Reviewing documentation.

Requirement: R20. A CAF compliant appraisal method shall provide guidance for consolidating the data collected during an appraisal that addresses at a minimum:

- Extracting information from data gathered during data collection sessions.
- Recording them as observations.
- Classifying the observations (e.g., as potential strengths or weaknesses).
- Categorizing the observations in terms of the CMM or categorizing them as non-CMM findings.

Requirement: R21. A CAF compliant appraisal method shall provide guidance for validating observations that includes corroboration of the observation by data obtained, at a minimum, from:

- Multiple and independent sources.
- Interviews or presentations that include people performing the related work or reviews that include documents that are products or records of that work.

Requirement: R22. A CAF compliant appraisal method shall provide guidance for validating observations that requires at a minimum that a portion of the observations related to each of the KPA goals within the scope of the appraisal are supported by a review of related documentation.

Requirement: R23. A CAF compliant appraisal method shall provide guidance for evaluating and documenting the sufficiency of findings relative to the scope of the appraisal, including coverage criteria that adhere to the following minimum set of rules for determining whether sufficient data exists to support rating:

- A goal is covered if sufficient findings exist to judge the extent of its implementation and institutionalization relative to the CMM, the appraised entity, and the appraised entity's life cycle(s) (including the existence of acceptable alternatives).
- A Key Process Area is covered if all of its goals are covered.

- A maturity level is covered if all of its Key Process Areas and all those of lower level KPAs are covered.

Requirement: R24. A CAF compliant appraisal method shall define mechanisms for adjusting data collection plans to obtain sufficient coverage.

Requirement: R25. A CAF compliant appraisal method shall provide guidance for recording traceability between the data collected during the appraisal and the appraisal outputs.

Requirement: R26. A CAF compliant appraisal method shall require rating of the following categories of CMM components provided they fall within the scope of the appraisal:

- KPAs
- Goals

Requirement: R27. A CAF compliant appraisal method, if it calculates a maturity level rating, shall require that the maturity level rating is consistent with the five level scale provided in the CMM.

Requirement: R28. A CAF compliant appraisal method shall define a rating process using the following rating values:

- A KPA or goal is satisfied if this aspect of the CMM is implemented and institutionalized either as defined in the CMM, or with an adequate alternative.
- A KPA or goal is unsatisfied if there are significant weaknesses in the appraised entity's implementation or institutionalization of this aspect of the CMM, as defined, and no adequate alternative is in place.
- A KPA or goal is not applicable if the KPA is not applicable in the organization's environment.
- A KPA or goal is not rated if the associated appraisal findings do not meet coverage criteria or if this aspect of the CMM falls outside the scope of the appraisal.

Requirement: R29. A CAF compliant appraisal method shall define a rating process which specifies that:

- An appraisal team can rate a goal when valid observations related to the goal meet the method's defined coverage criteria.
- An appraisal team can rate a KPA when it has rated each of the associated goals.
- An appraisal team can determine a maturity level rating once it has rated all of the KPAs within that level and each level below.

Requirement: R30. A CAF compliant appraisal method shall define a rating process that requires full participation of all appraisal team members in reaching consensus in all rating decisions.

Requirement: R31. A CAF compliant appraisal method shall require that ratings be based on the CMM as defined in *Capability Maturity Model for Software, Version 1.1* [Paulk 93a] and *Key Practices of the Capability Maturity Model, Version 1.1* [Paulk 93b].

Requirement: R32. A CAF compliant appraisal method shall define a rating process that requires appraisal teams to base ratings on their findings (observations that they have validated).

Requirement: R33. A CAF compliant appraisal method shall define a rating process which specifies that each goal is rated in accordance with the following rules:

- Rate the goal “satisfied” if the associated findings indicate that this goal is implemented and institutionalized either as defined in the CMM with no significant weaknesses or that an adequate alternative exist.
- Rate the goal “unsatisfied” if the associated findings indicate that there are significant weaknesses in the appraised entity’s implementation and institutionalization of this goal as defined in the CMM and no adequate alternative is in place.
- Rate the goal ‘not applicable’ if the KPA is not applicable in the organization’s environment.
- Rate the goal “not rated” if the associated findings do not meet the method’s defined criteria for coverage or if the goal falls outside of the scope of the appraisal.

Requirement: R34. A CAF compliant appraisal method shall define a rating process which specifies that each KPA is rated in accordance with the following rules:

- Rate the KPA “satisfied” if all of the goals are rated “satisfied.”
- Rate the KPA “unsatisfied” if any goal is rated as “unsatisfied.”
- Rate the KPA “not applicable” if the KPA is not applicable in the organization’s environment.

Requirement: R35. A CAF compliant appraisal method shall define a rating process which specifies that maturity level, if determined, is determined in accordance with the following rules:

- A maturity level is satisfied if all KPAs within that level and each lower level are satisfied or not applicable,
- The maturity level rating is that of the highest maturity level satisfied.

Requirement: R36. A CAF compliant appraisal method shall identify the reports that the appraisal team provides as the result of the appraisal process.

Requirement: R37. A CAF compliant appraisal method shall require that the appraisal team report the following data, at a minimum, to the sponsor:

- Appraisal scope.
- Appraisal selections (site, projects, participants, team members).

- Findings.
- Ratings.
- Risks associated with the accuracy and completeness of appraisal outputs.

Requirement: R38. A CAF compliant appraisal method shall report appraisal results to the SEI.

Requirement: R39. A CAF compliant appraisal method shall provide guidance for protecting the confidentiality of appraisal information.

Requirement: R40. A CAF compliant appraisal method shall provide guidance for retention of appraisal records.

Appendix B Mapping the Key Practices to Goals

Level 2 KPAs	Goals	Activities Performed	Commitment	Ability	Measurement	Verification
Requirements Management	1	1	1	1, 2, 3, 4	1	1, 2, 3
	2	2, 3	1	3, 4	1	1, 2, 3
Software Project Planning	1	9, 10, 11, 12, 15	1, 2	1, 3, 4	1	1, 2, 3
	2	2, 5, 6, 7, 8, 13, 14	1, 2	1, 2, 3, 4	1	1, 2, 3
	3	1, 3, 4	1, 2	1, 3, 4	1	1, 2, 3
Software Project Tracking and Oversight	1	1, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2	1, 2, 3, 4, 5	1	1, 2, 3
	2	2, 5, 6, 7, 8, 9, 11	1, 2	1, 2, 3, 4, 5	1	1, 2, 3
	3	3, 4	1, 2	1, 2, 3, 4, 5	1	1, 2, 3
Software Subcontract Management	1	1, 2	1, 2	1, 2	1	2, 3
	2	3, 4, 6	1, 2	1, 2, 3	1	1, 2, 3
	3	7, 8, 9, 13	1, 2	1, 2, 3	1	2, 3
	4	3, 5, 7, 9, 10, 11, 12, 13	1, 2	1, 2, 3	1	1, 2, 3
Software Quality Assurance	1	1, 2	1	1, 2, 3	1	2, 3
	2	2, 3, 4, 5	1	1, 2, 3, 4	1	2, 3
	3	6, 7, 8	1	1, 2, 3, 4	1	1, 2, 3
	4	7	1	1, 2, 3, 4	1	1, 2, 3
Software Configuration Management	1	1, 2	1	2, 3, 4	1	2, 4
	2	2, 3, 4, 7	1	1, 2, 3, 4, 5	1	4
	3	5, 6	1	1, 2, 3, 4, 5	1	4
	4	8, 9, 10	1	2, 3, 4, 5	1	1, 2, 3, 4

Table B-1: Level 2 KPAs: Key Practices Mapped to Goals

Level 3 KPAs	Goals	Activities Performed	Commitment	Ability	Measurement	Verification
Organization Process Focus	1	3, 4, 5, 6, 7	1, 2, 3	1, 2, 3, 4	1	1
	2	1	1, 2, 3	1, 2, 3, 4	1	1
	3	2	1, 2, 3	1, 2, 3, 4	1	1
Organization Process Definition	1	1, 2, 3, 4	1	1, 2	1	1
	2	5, 6	1	1, 2	1	1
Training Program	1	1, 2, 3	1	1, 2, 3, 4	1	1, 3
	2	3, 4	1	1, 2, 3, 4	1, 2	1, 2, 3
	3	5, 6	1	1, 2, 3, 4	1, 2	2, 3
Integrated Software Management	1	1, 2, 3	1	1, 2	1	2, 3
	2	3, 4, 5, 6, 7, 8, 9, 10, 11	1	1, 3	1	1, 2, 3
Software Product Engineering	1	1, 2, 3, 4, 5, 6, 7, 8, 9	1	1, 2, 3, 4	1, 2	1, 2, 3
	2	10	1	1, 2, 3, 4	1, 2	1, 2, 3
Intergroup Coordination	1	1	1	1, 2, 3, 4, 5	1	2, 3
	2	3, 4, 5	1	1, 2, 3, 4, 5	1	2, 3
	3	2, 6, 7	1	1, 2, 3, 4, 5	1	1, 2, 3
Peer Reviews	1	1	1	1, 2	1	1
	2	2, 3	1	1, 2, 3	1	1

Table B-2: Level 3 KPAs: Key Practices Mapped to Goals

Level 4 KPAs	Goals	Activities Performed	Commitment	Ability	Measurement	Verification
Quantitative Process Management	1	1, 2, 3	1, 2	1, 2, 4, 5	1	2, 3
	2	2, 4, 5, 6	1	1, 2, 3, 4, 5	1	1, 2, 3
	3	7	2	1, 2, 3, 4, 5	1	1, 3
Software Quality Management	1	1, 2	1	1, 2, 3	1	2, 3
	2	3, 5	1	1, 2, 3	1	2, 3
	3	2, 4	1	1, 2, 3	1	1, 2, 3

Table B-3: Level 4 KPAs: Key Practices Mapped to Goals

Level 5 KPAs	Goals	Activities Performed	Commitment	Ability	Measurement	Verification
Defect Prevention	1	1, 2	1, 2	1, 2, 3, 4	1	2, 3
	2	3, 5	1, 2	3, 4	1	3
	3	4, 6, 7, 8	1, 2	1, 2, 3, 4	1	1, 2, 3
Technology Change Management	1	1	1, 2, 3	1, 2, 5	1	2
	2	2, 4, 5, 6	1, 2, 3	1, 2, 3, 4, 5	1	1, 2
	3	3, 7, 8	1, 2, 3	1, 2, 5	1	1, 2
Process Change Management	1	2, 3, 4	1, 2	1, 2, 3	1	2
	2	1, 6, 10	1, 2	1, 2, 3, 4	1	1, 2
	3	4, 5, 7, 8, 9	1, 2	1, 2, 3, 4	1	1, 2

Table B-4: Level 5 KPAs: Key Practices Mapped to Goals

Appendix C References

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Appendix D Glossary

ability to perform - One of five common features. The preconditions that must exist in the project or organization to implement the software process competently. Ability to Perform typically involves resources, organization structures, and training.

accuracy - An observation is considered to be accurate if the appraisal team agrees that it is based on what is heard and seen, is worded appropriately, and is correctly categorized and classified.

activities performed - One of five common features. A description of the roles and procedures necessary to implement a key process area. Activities performed typically involves establishing plans and procedures, performing the work, tracking it, and taking corrective action.

activity - A key practice of the activities performed common feature.

alternative practice - Alternative practices to those described in the CMM that may accomplish the goals of a key process area.

appraisal constraints - Constraints that affect appraisal conduct such as budget limitations, schedule limitations, and resource limitations (people and facilities).

appraisal goals - The desired outcome of an appraisal process.

appraisal requirements - Appraisal constraints and goals.

appraisal scope - The organizational entities and CMM components selected for investigation.

appraisal sponsor - The individual who authorizes an appraisal, defines its goals and constraints, and commits to use of appraisal outputs.

appraised entity - The organizational units to which appraisal outputs apply. An appraised entity may be any portion of an organization including an entire company, a selected business unit, a specific geographic site, units supporting a particular product line, units involved in a particular type of service, an individual project, or a multi-company team.

Capability Maturity Model (CMM) - A description of the stages through which software organizations evolve as they define, implement, measure, control, and improve their software processes. This model provides a guide for selecting process improvement strategies by facilitating the determination of current process capabilities and the identification of the issues most critical to software quality and process improvement. CMM Version 1.1 is specified in CMU/SEI-93-TR-24 and CMU/SEI-93-TR-25.

categorize observations - Identify the key practices, common features, goals, and KPAs related to the observation.

CAF - Acronym for *CMM Appraisal Framework*.

CAF compliant appraisal method - An appraisal method that conforms to CAF defined appraisal method requirements.

CBA - Acronym for *CMM-Based Appraisal*

classify observation - Classify an observation as evidence of:

- A strength in implementation of CMM key practices,
- A weakness in the implementation of CMM key practices,
- The existence of an alternative practice that meets KPA goals, or
- The existence of a practice that is not-applicable or not-significant in an organization's business context.

CMM - Acronym for *capability maturity model*.

CMM Appraisal Framework (CAF) - A framework for planning, conducting, and completing CMM-based appraisals.

CMM-based appraisal (CBA) - An appraisal conducted using a CMM-based appraisal method.

CMM-based appraisal method - An appraisal method that uses the CMM as its framework for evaluating an organization's software process.

CMM fidelity - The use of CMM components, and CMM components alone, as the basis for rating an organization's software process maturity.

CMM scope of the appraisal - The portion of the CMM used as a framework for evaluating an organization's software process during an appraisal.

commitment - A pact that is freely assumed, visible, and expected to be kept by all parties.

commitment to perform - One of five common features. The actions that the organization must take to ensure that the process is established and will endure. Commitment to Perform typically involves establishing organizational policies and senior management sponsorship.

common feature - The subdivision categories of the CMM key process areas. The common features are attributes that indicated whether the implementation and institutionalization of a key process area is effective, repeatable, and lasting. The CMM common features are the following:

- Commitment to perform,
- Ability to perform,

- Activities performed,
- Measurement and analysis, and
- Verifying implementation.

comparability - The degree to which the results of different appraisal methods are similar.

confidentiality - a characteristic of data that, by agreement, can not be attributed to a particular individual or disclosed without prior agreement or authorization.

consensus - A method of decision making that allows team members to develop a common basis of understanding and develop general agreement concerning a decision.

consistency - The degree of uniformity, standardization, and freedom from contradiction among documents or system components. Consistency of an appraisal method refers to the ability of different appraisal teams using the same method to conduct appraisals of the same scope to produce non-conflicting results.

corroboration - Confirmation. All appraisal observations must be confirmed by information from different sources and different data gathering sessions prior to use as findings.

coverage - The extent to which data gathered addresses CMM components, organizational units, and life cycle phases within the scope of an appraisal.

covered - A CMM component is considered to be covered if the data gathered relevant to the component:

- Is representative of the organizational units within the scope of the appraisal,
- Is representative of the life cycle phases within the scope of the appraisal,
- Addresses an adequate sample of sub-components.

effective process - A process that can be characterized as practiced, documented, enforced, trained, measured, and able to improve.

fact - A statement whose content can be verified as true through the senses.

finding - An observation that has been accepted by the team as valid. Findings include strengths, weaknesses, evidence of alternative practices, and evidence of non-applicable practices. A set of findings should be accurate, corroborated, and consistent within itself.

goal - A summary of the key practices of a key process area that can be used to determine whether an organization or project has effectively implemented the key process area. The goals signify the scope, boundaries, and intent of each key process area.

inference - A conclusion based on fact. In appraisals, the most frequent inferences are that the statements made by people in interviews as part of the oral discussion are facts.

judgments - The exercise of making sound and reasonable decisions. Judgments refer to assertions that are made that are based on facts and strong inferences.

IIDEAL approach - A life cycle model for process improvement. IDEAL stands for the five phases of the approach: Initiating, Diagnosing, Establishing, Acting, and Leveraging.

institutionalization - The building of infrastructure and corporate culture that support methods, practices, and procedures so that they are the ongoing way of doing business, even after those who originally defined them are gone.

institutionalization common feature - One of the four common features: commitment to perform, ability to perform, measurement and analysis, and verifying implementation.

instrument - Questionnaire or survey used to collect data using formal, written questions.

IPI - Acronym for CMM-Based Appraisal for Internal Process Improvement.

key practice - The infrastructures and activities that contribute most to the effective implementation and institutionalization of a key process area.

key process area - A cluster of related activities that, when performed collectively, achieve a set of goals considered important for establishing process capability. The key process areas have been identified by the SEI to be the principal building blocks to help determine the software process capability of an organization and understand the improvements needed to advance to higher maturity levels.

KPA - Acronym for *key process area*.

maturity level - A well-defined evolutionary plateau toward achieving a mature software process. The five maturity levels in the SEI's Capability Maturity Model are initial, repeatable, defined, managed, and optimizing.

measurement and analysis - One of five common features. A description of the need to measure the process and analyze the measurements. Measurement and Analysis typically includes examples of the measurements that could be taken to determine the status and effectiveness of the Activities Performed.

not applicable - Rating given to a CMM component that is either not applicable or insignificant in an organization's business environment.

not rated - Rating given to a CMM component that fall outside the scope of an appraisal and to CMM components for which the appraisal team did not obtain coverage.

observation - Information extracted from the notes of data collection sessions.

organization scope of an appraisal - The organizational units that comprise the entity being appraised.

process - A sequence of steps performed for a given purpose.

process capability - The range of expected results that can be achieved by following a process.

process maturity - The extent to which a specific process is explicitly defined, managed, measured, controlled, and effective. Maturity implies a potential for growth in capability and indicates both the richness of an organization's software process and consistency with which it is applied in projects throughout the organization.

project - An undertaking requiring concerted effort, which is focused on developing and/or maintaining a specific product. The product may include hardware, software and other components. Typically a project has its own funding, cost accounting, and delivery schedule.

rating - A characterization of an organization's software process relative to a component of the CMM.

rating components - Components of the CMM that can be rated include goals, KPAs, and maturity level.

rating scale - The rating scale for goals and KPAs is satisfied, unsatisfied, not applicable, and not rated. The rating scale for maturity level is 1 through 5.

reliability - The ability to attain appraisal results that accurately characterize an organization's software process.

repeatability - The ability to attain the same appraisal results if an appraisal of identical scope is conducted more than once in the same time period.

rules for corroborating observations - rules that define the requirements for confirming observations through the use of multiple data sources and sessions of prescribed types.

sampling - A set of elements drawn from and analyzed to estimate the characteristics of a population. During an appraisal data collection is planned to provide a sampling of the process data related to the CMM components, organizational units, and life cycle phases within the scope of the appraisal.

satisfied - Rating given to a CMM component that is applicable in an organization's business environment and is performed either as defined in the CMM or with an adequate alternative.

SCE - Acronym for Software Capability Evaluation.

SEI - Acronym for Software Engineering Institute.

senior site manager - senior manager in charge of the appraised entity. The senior site manager may or may not be the appraisal sponsor.

site - a geographic location of one or more of an organization's units.

SPA - Acronym for Software Process Assessment.

strength - Implementation of practices which in an appraisal team's judgment, improve an organization's software process capability. CMM related strengths are effective implementation of one or more of the CMM key practices or one or more alternative practices that contribute equivalently to the satisfaction of KPA goals.

subpractice - listed beneath top-level key practices in the CMM and describe what one would expect to find implemented for the top-level key practice. The subpractices can be used to determine whether or not the key practices are implemented satisfactorily.

sufficiency for rating - The extent to which findings meet the appraisal method's rules for coverage and, thus, satisfy the prerequisites for rating.

support unit - An organizational level unit that supports one or more projects in software process performance, such as a Software Engineering Process Group.

traceability - The degree to which a relationship can be established between two or more products of the appraisal process, especially products having a predecessor -successor relationship to on another.

unsatisfied - Rating given to a CMM component that is both applicable and significant in an organization's business environment, is either not performed or is performed as defined in the CMM with significant weaknesses, and for which no adequate alternative exists.

verifying implementation - One of five common features. The steps to ensure that the activities are performed in compliance with the process and that has been established. Verification typically encompasses reviews and audits by management and software quality assurance.

weakness - Ineffective implementation of or lack of practices which in an appraisal team's judgment, interfere with effective performance of software development tasks. CMM related weaknesses are an ineffective implementation or lack of implementation of one or more CMM key practices with no acceptable alternative practices in place.

Change Request

CMM Appriasal Framework, Version 1.0.

SEI assigned tracking number:

Date:

Name of submitting organization:

Organization contact:

Telephone:

Email address:

Mailing address:

Location of proposed change (e.g., section and page #, global):

Proposed change:

Rationale for proposed change:

Note: For the SEI to take appropriate action on a change request, we must have a clear description of both the proposed change and the rationale.

Send U.S. mail to: CAF Change Requests / Software Process Program / Software Engineering Institute / Carnegie Mellon University / Pittsburgh PA 15213-3890

Send via Internet to: cafchange@sei.cmu.edu

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19. ABSTRACT (continue on reverse if necessary and identify by block number) This technical report describes version 1.0 of the CMM Appraisal Framework (CAF). This framework describes the common requirements used by the CMM-Based Appraisal (CBA) project in developing appraisal methods based on the Capability Maturity Model (CMM) for Software, Version 1.1 [Paulk 93a]. The CAF provides a framework for rating the process maturity of an organization against the CMM. The CAF includes a generic appraisal architecture for CMM-based appraisal methods and defines the requirements for developing CAF compliant appraisal methods. <div style="text-align: right;">(please turn over)</div>					
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